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**A SYSTEM EVALUATION OF CONSOLIDATED
FIELD FEEDING FOR THE ARMY**

Robert S. Smith, et al

**Army Natick Laboratories
Natick, Massachusetts**

February 1975

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A SYSTEM EVALUATION OF CONSOLIDATED
FIELD FEEDING FOR THE ARMY

NATIONAL TECHNICAL
INFORMATION SERVICE

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UNITED STATES ARMY
Natick Laboratories
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Operations Research/Systems Analysis Office

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ABSTRACT

A systems analysis was performed to determine the feasibility and manpower reduction potential of the Army's present field feeding system by consolidating the kitchens. Using an approved scenario involving four divisions, a plan for consolidation was developed. Based on this plan, nine alternative concepts were evaluated for personnel reductions, cost savings, and system effectiveness. The conclusion was that a consolidated field feeding concept for the Army is feasible and can result in reducing the number of kitchens in a typical division from 115 to 50.

Three of the nine alternative systems were considered superior. Of these, the preferred system, based on systems effectiveness criteria, employed a mix of mobile field kitchen trailers and kitchen tents, and utilized disposable trays and utensils to replace the standard mess kit.

Personnel reductions and cost savings which resulted from consolidation, using the preferred system were; a 40% reduction in food service personnel; a 58% reduction in kitchen attendants (K.P.'s) and savings in the annual cost of the food service operation (for the four divisions) of over \$22 million.

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FOREWORD

The Operations Research/Systems Analysis Office of the U.S. Army Natick Laboratories has an on-going study of food service systems in combat environments for the Army and Marine Corps. The major objectives of this study are to: (1) develop recommendations to reduce manpower requirements and to improve performance for the existing system; and, (2) define and recommend new systems based on technological advances, which would minimize manpower requirements and further improve performance.

The Quartermaster School at Ft. Lee has been tasked by TRADOC to determine the potential manpower savings associated with changing the Army policy of preparing raw food at a company level under combat conditions to preparing food at a battalion level. As part of this task, the Quartermaster School reviewed the progress of the NLABS study and requested NLABS to expedite its efforts to evaluate the potential manpower savings associated with alternative consolidated feeding systems for use under combat conditions. This report documents the results of this effort.

CHAPTER I

INTRODUCTION

Background

Throughout the history of the Army, the predominant mode of feeding in the field has been in company level groups ranging in size from 100 to 250 men. This company level concept is the product of an evolutionary process which dates back to the Revolutionary War period. The establishment and continuation of feeding at the company level in the Army has been traditionally associated with the fact that the company is the basic administrative, social and tactical unit within the Army. Of prime importance has been the need for some companies to operate independently under combat conditions, thereby requiring a separate subsistence capability.

With the company feeding policy, food service is under the direction of the unit commander who is primarily responsible for assuring that his soldiers are provided adequate subsistence. Each company is authorized a complete field kitchen and the requisite food service personnel. Furthermore, the food service staff has to be augmented by lower grade enlisted personnel (kit-tan attendants), who perform sanitation type functions and assist the cooks, on a duty roster basis. The unit commander, in supplying subsistence to his troops, is dependent upon the Class I supply system which provides combat rations and raw food for his company kitchen on an established cyclical basis.

The current company feeding system is extremely simple in terms of equipment and organizational structure. However, when this system is required to provide subsistence for a large theater of operations, it becomes massive in scale. Consider, for example, the expense incurred annually by this system in support of a typical division of 16,574 soldiers operating under combat conditions:

Food	\$16,233,000
Labor	12,670,000
Transportation	2,148,000
Fuel, Water, Equipment	1,865,000
Total Annual Cost	\$32,916,000

In the labor category above, 1072 personnel are required to make this system function. This represents approximately 6.5% of the total division strength.

It is apparent from the above figures that the current system of combat feeding uses substantial amounts of scarce labor and other resources. The Army policy of preparing food in company level kitchens for 100 to 250 troops dictates the current high level of resource use in this system. It is well-known that the smaller the kitchen operation the less efficient it is. Therefore, the expenditure of these critical resources can be substantially reduced if this company kitchen concept can be relieved.

¹ Prescott, S.C., "A Survey of Rationing and Subsistence in the United States Army, 1775 to 1940," National Defense Research Committee, Office of Scientific Research & Development, Washington, DC, March, 1944.

During the past thirteen years, the Army has experienced significant increases in the cost of labor. An E-5 of 1962 was paid approximately \$3,700 (direct wages and benefits) annually. By comparison, his 1975 counterpart is paid \$9,584. This almost threefold increase in wages and benefits is even more significant when other costs are considered. For example, the current annual labor costs (including support, training, medical, etc.) for an E-5 cook totals \$13,548 per year. When labor costs were substantially lower, the number of support troops was not as major a concern as it is today. Because of this increased cost of labor, the Army's current efforts are to increase the "teeth to tail ratio" by reducing the number of support troops. With this objective in mind, it is essential that the manpower requirements for food service be re-evaluated. In this evaluation, it is important that mission requirements are not compromised. However, it is of equal importance that reasonable alternatives for feeding troops under combat conditions be considered and analyzed for potential manpower savings.

This report covers the potential manpower and other resource savings associated with consolidated systems of food preparation for divisional units. Unit mission and method of employment have been emphasized in this analysis and only those elements which can be adequately supplied with hot food from a consolidated kitchen have been recommended for consolidation. Units with special requirements, and those that normally operate in compact formations, have retained company-sized kitchens.

It is important to note that this analysis applies to divisional units only and not to Corps units. Since the organization of Corps troops is not constant, but is built up of units on an "as required" basis, it is much more difficult to develop a plan of consolidation for one type Corps that will prove satisfactory for all theaters of operation. Further, consideration will be given to developing consolidation plans for Corps elements, as part of the overall systems analysis study of field feeding.

Objectives:

The objectives of this analysis are to:

1. Assess the feasibility of consolidated field feeding for the Army.
2. Develop a rationale for accomplishing consolidation of food preparation for the various tactical units.
3. Define a plan for consolidation of food preparation including requisite organizational and equipment changes.
4. Define several alternative systems which utilize different types of kitchen shelters.
5. Determine the manpower and cost reduction potential of these alternative systems using the plan of consolidation.
6. Determine the economic and personnel reductions which can be achieved through the introduction of disposables.
7. Select and recommend the preferred system(s) for adoption.

Field Feeding - The Present System

The mission of the company kitchen in the present system is to transform the delivered food products into hot meal(s) for the troops operating under field conditions. The Office of the Surgeon General has recommended against subsisting troops on individual or bulk operational rations for extended time periods. Thus, there is an essential mission requirement for hot meals. In addition, a hot meal is a significant troop morale factor.

Hot meal preparation in the field is conducted in the proximity of the organic company or in the brigade field trains area. In situations where the kitchen is located near its company, meals are prepared and served at the kitchen site. However, this method is not always satisfactory under tactical situations since the kitchen is vulnerable and its presence can easily compromise the company's efforts at concealment. Further, it requires soldiers to leave their fighting positions for extended periods of time. Since everyone cannot be allowed to leave their positions simultaneously, the serving period is usually very long.

Alternatively, when the kitchen is located in the brigade field trains area, at a distance of up to 25 kilometers from the company, the prepared food must be placed in insulated containers and delivered together with all the equipment required to set up a mess kit laundry line. This means that fuel, water and most of the food service personnel must be transported to a central location in the company area. Once the serving line and the mess kit sanitation line are set up, the procedure is the same as above. The advantages of this approach over the former are: (a) the vulnerability of the kitchen is reduced by keeping it out of the forward combat areas, (b) company concealment is easier, and (c) the location of feeding is generally closer to the troop positions thereby reducing the duration of the meal period.

The equipment furnished with the company kitchen to prepare hot food is rudimentary in design and is essentially the same equipment designed in 1937 and used extensively throughout World War II and Korea. The current field kitchen is not a complete standardized sub-system, but rather a conglomeration of items of equipment issued to each company based on unit strength. The equipment usually consists of a kitchen tent, range cabinets, burner units, cooking pots with cradles, pans, immersion heaters and water cans, and various utensils. The final configuration of a given field kitchen, however, is dependent in large part upon the ingenuity of the mess sergeant.

The use of this equipment is usually dependent on the menu which is served. It varies from using the burner unit, cradle and cook pot to heat hot components or water for hot components of packaged individual rations to preparing and serving a garrison type "A" ration menu. When full garrison type menus are prepared and served, the equipment has serious deficiencies which include but are not limited to, lack of refrigeration, insufficient grilling capacity and unsatisfactory hot food holding and serving equipment. The mess kit laundry system also has serious deficiencies. More important, however, is the increase in workload for the cooks and the extreme difficulties they have in preparing complex menus for troops under combat conditions.

In spite of all the serious problems and difficulties associated with the existing company system of feeding the troops in the field, this system does work in support of combat missions. In the past year, the authors have observed this system functioning in six different field exercises. In each case, the food service provided to the customer has, on the whole, been good despite the many serious difficulties that have to be overcome by the food service personnel.

General Approach

The mission requirements must dictate the definition and design of the combat food service system. Therefore, this evaluation commenced with a comprehensive analysis of the mission, functions and concepts of operation for the various units in a given force. The initial concern was the definition of the combat force and its overall mission assignment. Three factors determined the definition of the deployed force that was used in this analysis: (a) The force had to be small enough to allow the conduct of an exacting detailed analysis; (b) the force had to be large enough to be supported by a large food service system to make the dimensions of the analysis meaningful; and, (c) the force had to be a specific force covered by an approved Army scenario to insure that the most current and realistic battlefield conditions were used.

With the assistance of personnel from the Quartermaster School and Logistics Center at Fort Lee, the Training and Doctrine Command's latest European scenario was selected. A 1:50,000 map of the specific area of operations was used to dispose all assigned units (combat, combat support and combat service support) in a defensive posture within a given corps area. By analyzing the mission and locations of these units, it was possible to develop a plan for consolidation which is detailed in Appendix A. This analysis convinced the authors that significant consolidation of food service was feasible. However, some units, due to mission requirements and other special considerations, had to retain their company kitchens. Nevertheless, the authors' plan for consolidation resulted in reducing the average number of kitchens in a typical division from 115 to 50. The rationale used is detailed in Chapter II.

The foregoing analysis provided the basis for identification of those units which could be supported by consolidated kitchens. Once this was determined, the different troop strengths were recorded for each of the kitchens together with the different types of feeding requirements, (i.e., on site vs. delivery). Using these data, the various alternative systems of feeding were defined. The major thrust of these systems was to minimize manpower. Also, maximum use was made of existing and/or available equipment and supplies including the new Mobile Field Kitchen Trailer to insure that the systems could be adopted without long term R&D activities.

The total cost in manpower and dollars was then developed for the existing system and for each new alternative system. These systems were then compared to each other and recommendations offered as to which alternative systems should be further evaluated and tested.

CHAPTER II

ASSUMPTIONS AND RATIONALE FOR CONSOLIDATION

The analysis of alternative systems necessitated a number of assumptions so that all of the significant parameters of the competing systems could be quantified. The assumptions made in this evaluation are listed below:

1. Specific divisional units whom because of mission requirements or operational concepts need company kitchens will retain them. All other units will be supported by consolidated kitchens at some level above the company.
2. Food service personnel will deliver hot, prepared food from the consolidated kitchens to a limited number of staging areas (combat trains of maneuver battalions). Final distribution and service of food to the consumer will be the responsibility of company or smaller unit commanders.
3. Troops in the immediate proximity of the consolidated kitchen will be served at the kitchen site.
4. For the first 30 days of operations, hot meals will be based on the "B" ration. Thereafter, a modified "A" ration menu will be used. Individual operational rations will be consumed throughout the entire 12 months, as required, and constitute approximately 23% of all rations served.
5. The alternative systems defined herein will be operated in a non-nuclear environment. In an active nuclear environment, preparation and consumption of hot meals would not be practical and units will have to depend on the individual operational ration.
6. Food is an extremely important factor influencing troop morale and efficiency. Therefore, system changes should do nothing to degrade the quality of food when compared to the present system.

It should be noted that additional assumptions, pertaining to the alternatives and economic analysis, are contained in Chapters V and VI, respectively.

RATIONALE FOR CONSOLIDATION

The level of consolidation of units for food service is variable, i.e., not all consolidated kitchens serve the same number of troops. Troop strengths of consolidated kitchens range from a low of 163 to a high of 988. The principal criteria employed to determine which troops could be supported with hot food from consolidated kitchens were the mission and employment of individual units. All divisional units were considered, although no attempt was made to consolidate the Corps Units. The major groupings of the divisional units are:

1. Maneuver Battalions
2. Headquarters Elements
3. Cavalry Squadrons
4. Combat Support Units
5. Combat Service Support Units

Maneuver Battalions - The battalion is the basic building block for higher echelon formations, i.e., brigades and divisions. Therefore, the battalion normally maintains its integrity under various tactical conditions except for cross-attachment of some company sized units to form combined arms task forces. Further, the battalion's subordinate companies depend upon one another for mutual fire support. They are also dependent upon higher echelons for most of their combat and combat service support. Consequently, the factors which either allow or preclude the feeding of a hot meal will in general be applicable to all elements of a maneuver battalion. Because of their close proximity and interdependence upon each other, companies within these maneuver battalions can be effectively supported from consolidated kitchens.

Headquarter Elements - When committed on the battlefield, the troop population in the immediate vicinity of headquarters installations, such as the brigade and division command posts and the Support Command Headquarters, swells beyond the support capability of the organic headquarters company field messes. For example, a typical Mechanized Infantry Division Headquarters complex includes an augmentation of about 275 personnel from the Signal, Engineer, Artillery, Military Police, Aviation, Military Intelligence, Army Security Agency, and other supporting units and services. It is clearly impractical for the parent organization of each of these small detachments to provide them with food service. Consequently, the division Headquarters and Headquarters Company (HHC) mess is normally augmented by a unit mess from one of the subordinate elements (i.e., a company mess from the reserve Brigade) which deprives that unit of its organic field feeding capability. What is needed is an augmentation capability specifically designed for this purpose which would allow consolidated preparation and feeding for all personnel within these headquarters installations. Preparation of hot food in a consolidated kitchen can practically support all assigned and attached troops within the Headquarter element area. Such a capability is provided by the proposed Food Service Company discussed in Chapter III.

Cavalry Squadrons - The organization of divisional armored cavalry squadrons varies with the type of division to which assigned. Nevertheless, they all have a headquarters and headquarters troop and a number of armored and air cavalry troops. The troops are normally employed under squadron control, but occasionally are employed in semi-independent operations for limited periods, or attached to brigades. In either case, the squadron or individual troops are employed on reconnaissance and security missions, or in an economy of force role, which normally entails greater dispersion and mobility than is the case with other maneuver elements. For this reason, the armored cavalry troop is seldom in a position to consume a hot meal at the kitchen site, and relies on squadron ground or air transportation for delivery of hot meals or other rations to widely dispersed locations. Elements of the air cavalry troop, however, must return regularly to a base (trains) for refueling, rearming and maintenance. Additionally, their activity is reduced considerably during hours of darkness. During these periods, hot meals may be consumed at a central mess within the trains area.

Because of the differences in the mix of armored and air cavalry troops in the various divisions, no single consolidation approach will satisfy each situation. Nevertheless, consolidated food preparation for the squadron appears practical and highly desirable. Sufficient transportation resources are available to accomplish delivery to widely dispersed units. The consolidated kitchen will prepare hot food for delivery to troops in dispersed positions and for on site feeding of troops in the base area.

Divisional Combat Support Units

Field Artillery - Field artillery units are normally deployed in battery formations which are dispersed, laterally and in depth, to the rear of the forward maneuver elements. Their mode of operation is characterized by frequent battery displacement in response to movement of the maneuver units, and as a defensive measure against enemy fire. The battery is a relatively small and very compact formation, and is ideally suited to company-level feeding right from the kitchen. Consolidation of food service for the firing batteries under the present field feeding system would degrade the responsiveness of the feeding system and would require additional transportation and sanitation equipment. However, consolidated field feeding of the HHC and the service battery of the battalion from a single consolidated battery-level kitchen is considered practical and economical.

Combat Engineers - Employment of the combat engineer battalion is dictated by the situation to such an extent that one day the combined resources of several companies may be committed to a major task in a certain area, and the next day the unit may be fragmented and attached by platoons and squads to subordinate maneuver elements. Under these conditions, it is extremely difficult for the engineer unit commanders to effectively operate unit messes at any level. The most reliable and practical method for feeding such units would be through combination of attachment to other messes, and the drawing of prepared, packaged hot meals from the nearest consolidated area kitchen. The area kitchen concept is presented in Chapter III.

Signal Battalion - The signal battalion is organized functionally to provide communications support to a number of headquarters elements, as well as all other units in the division sector on an area basis. In order to accomplish their mission, elements of the signal battalion are dispersed throughout the division sector, laterally and in depth. To consider consolidation of this unit at battalion level is clearly impractical. Even company level messing requires considerable effort to deliver prepared meals to widely dispersed subordinate elements. The headquarters support elements of this unit can best be served by attachment to the augmented headquarters messes. All other elements can draw prepared, packaged meals from the nearest consolidated area kitchen.

Military Police Company - Employment of the military police company normally results in fragmentation and dispersion of the unit throughout the division sector. The most practical approach to feeding elements of this unit is through attachment to the various augmented headquarters messes, and in isolated cases by drawing prepared, packaged meals from the nearest consolidated area kitchen.

Aviation Company/Battalion - It is the authors' considered opinion that under the present system all aviation units should have organic company messes to insure maximum responsiveness to the peculiar demands placed on aviation unit personnel and equipment. However, some economy can be achieved by consolidating the maintenance battalion's transport aircraft maintenance company with the division aviation company since they are normally co-located. Subsistence for the aviation battalion was consolidated into two kitchens, one for the HHC and the aviation general support company and one for the assault helicopter company and the transport aircraft maintenance company of the maintenance battalion.

Air Defense Artillery - Units of the ADA battalion are normally dispersed throughout the division sector to provide air defense on an area basis, as well as point defense of certain critical installations. Even at battery level, feeding a hot meal to widely dispersed firing sections is a very demanding, time-consuming and inefficient proposition. These units can be much better served by relieving them of field kitchens entirely, and having them draw prepared meals from the nearest consolidated area kitchen.

Divisional Combat Service Support Units - Units of the division support command are generally organized to provide logistical support on an area basis. Elements of these units are usually grouped functionally around major logistical installations such as the brigade trains and other support installations further to the rear. With the exception of the Division Support Command (DISCOM) HHC and the Medical Battalion, all other DISCOM units can be effectively fed from the consolidated area kitchens, many of which will be co-located with the various logistical groupings. As a major subordinate headquarters (often also acting as the division rear command post) the DISCOM HHC mess section should be augmented to provide capability of feeding all personnel in the immediate vicinity of the DISCOM headquarters, including the headquarters of the S&T and the maintenance battalions which may be co-located. The Medical Battalion should retain company-level kitchens to facilitate patient feeding and support 24-hour operations.

Based on the preceding assumptions, rationale for consolidation and the TRADOC scenario, the four divisions were analyzed to identify where kitchen consolidation would be practical. The results of this consolidation, which are detailed in Appendix A, are shown in Table I. It is important to note that a significant number (109) of kitchens have been retained as company size kitchens due to mission requirements. Nevertheless, the proposed consolidation will reduce the total number of kitchens for the four divisions from 441 to 197 and the average number of kitchens per division from 115 to 50.

The results of this analysis together with the scenario dimensions, troop placement densities, etc., were used to design the consolidated kitchens for each of the alternative systems.

TABLE I
CONSOLIDATION SUMMARY
KITCHEN REQUIREMENTS BY CAPACITY (4 DIVISIONS)

Capacity of Kitchens	Armor Div	Inf. Div (M)	Inf. Div (M ¹)	Inf Div	No of Kitchens ²
100	19	19	19	21	78
200	9	8	8	6	31
300		1	1	2	4
400	10	10	10	10	40
500					
600	6	4	5	1	16
700	1	1	1		3
800				7	7
900	5	5	6	1	17
1000	—	—	—	—	—
TOTAL ³	50	48	50	49	197

¹This Mechanized Infantry Division has 5 Tank Battalions and 6 Infantry Battalions.

²Number of kitchens of each size

³Number of kitchens per division

CHAPTER III

SYSTEM REQUIREMENTS AND DEFINITION OF ALTERNATIVE SYSTEMS

The determination of equipment and staffing levels for the alternative systems must be based on certain constraints which govern their operation. These constraints include:

1. Supporting the food service needs (hot meals) of the entire division for up to a 12-month period.
2. Providing up to three hot meals per day (when troops are in rear areas).
3. Having sufficient flexibility to be used in a variety of tactical and geographical conditions.
4. Providing multi-course hot meals ranging from a "B" ration to a modified "A" ration. These meals must constitute a balanced, highly acceptable diet meeting established nutritional standards.
5. Having sufficient water for cooking and kitchen sanitation purposes only. Water for drinking, mess kit sanitation (where applicable), and personal hygiene although included in the costs, will be the responsibility of the individual companies.
6. Having adequate responsiveness to support local variations in customer load caused by temporary functional groupings of troops and units which are attached for rations.
7. Operating under blackout conditions.

Definition of Alternative Systems

This analysis considers three alternatives for combat feeding systems which consist of both company and consolidated kitchens. Within each alternative there are three different options for hot food delivery and service. Each alternative can be combined with any option yielding nine possible systems as shown in Table 2.

TABLE 2
SUMMARY OF ALTERNATIVES AND OPTIONS
FOR CONSOLIDATED SYSTEMS

Alternatives

	2	3
A M-1959/1975 kitchen with tents; standard insulated container and mess kit	Combination of MFKT,* M-1959/1975 kitchens with tents; standard insulated container and mess kit	MFKT's only; standard insulated container and mess kit
Options M-1959/1975 kitchen with tents; standard insulated container and disposable trays and utensils	Combination of MFKT, M-1959/1975 kitchens with tents; standard insulated container and disposable trays and utensils	MFKT's only; standard insulated container and disposable trays and utensils
B M-1959/1975 kitchens with tents; disposable insulated container and disposable trays and utensils	Combination of MFKT, M-1959/1975 kitchens with tents; disposable insulated container and disposable trays and utensils	MFKT's only; disposable insulated container and disposable trays and utensils
C M-1959/1975 kitchens with tents; standard insulated container and mess kit		

*MFKT - Mobile Field Kitchen Trailer

It should be emphasized that all alternatives are based on the same concept for consolidation and thus consist of the same number of kitchens (197).

Alternative 1 - This alternative utilizes the present M-1959 kitchen and equipment in situations up to 549 troops assigned. This kitchen is augmented with additional standard equipment when used for the higher feeding strengths. A new kitchen designated M-1975, is employed for feeding over 549 troops since the capacity of the M-1959 kitchen is exceeded above this level. The M-1975 kitchen (Figure 1) is housed in a general purpose medium tent, and uses the same equipment as the standard M-1959 kitchen. Existing items of equipment, (ranges, burners, etc) have been added to meet feeding strength requirements.

Alternative 2 - This concept used the new Mobile Field Kitchen Trailer (MFKT) where troop assignments do not exceed 349, and M-1959/M-1975 kitchens where over 349 troops are assigned. This alternative assumes that the MFKT is not adaptable when combined into multiple units for higher feeding levels, even though it has proved efficient in company-size operations. Therefore, the M-1959 kitchen is utilized where troop assignments range from 350 to 549, while the M-1975 kitchen is used where troop assignments range from 550 to 1000.

Alternative 3 - in this alternative it is assumed that the MFKT is adaptable and can function properly when two or more are combined into consolidated kitchens. Therefore, all four divisions are equipped solely with MFKT's which are used in various multiples depending upon feeding strengths. (One MFKT for up to 349; two MFKT's for 350 to 649 troops; three MFKT's for 650 to 1000 troops). An artist's concept of three MFKT's being utilized as a consolidated kitchen is shown in Figure 2. This concept envisions three MFKT's being grouped together with folding ramps (covered by a soft shelter) among them. Additional ranges and work tables can be placed on the ramps, when required.

Each of the preceding alternatives can be combined with any of the three options listed below, (i.e., the options are independent of the alternatives). These options primarily affect the sanitation workload (i.e., the type of mess gear and containers to be used to transport the food).

Option A - This option requires that soldiers use existing mess kits and eating utensils. Therefore, a number of mess kit laundry lines must be maintained, one located at the kitchen for those troops who are served there, the remainder at the various companies in the forward areas. Although water and equipment for the laundry mess kit line is the responsibility of each company, the manpower to operate these lines will come from the attendants assigned to the kitchen. In this option, hot food is transported in the standard insulated container which is sanitized at the kitchen. Because of the use of mess kits and insulated containers, sanitation requirements are greatest with this option.

Option B - The standard mess kit is replaced with a compartmented disposable tray and the canteen cup is used for beverages. Disposable eating utensils are also used. A disposable wipe is provided for cleaning the canteen cup. The sanitation workload is greatly reduced with this option, as laundry lines are eliminated in forward areas. As with Option A, food is transported using the standard insulated container which requires sanitation at the kitchen site.

Option C - This option is the same as B except a disposable insulated food container is utilized. The sanitation workload is therefore minimum with this option.

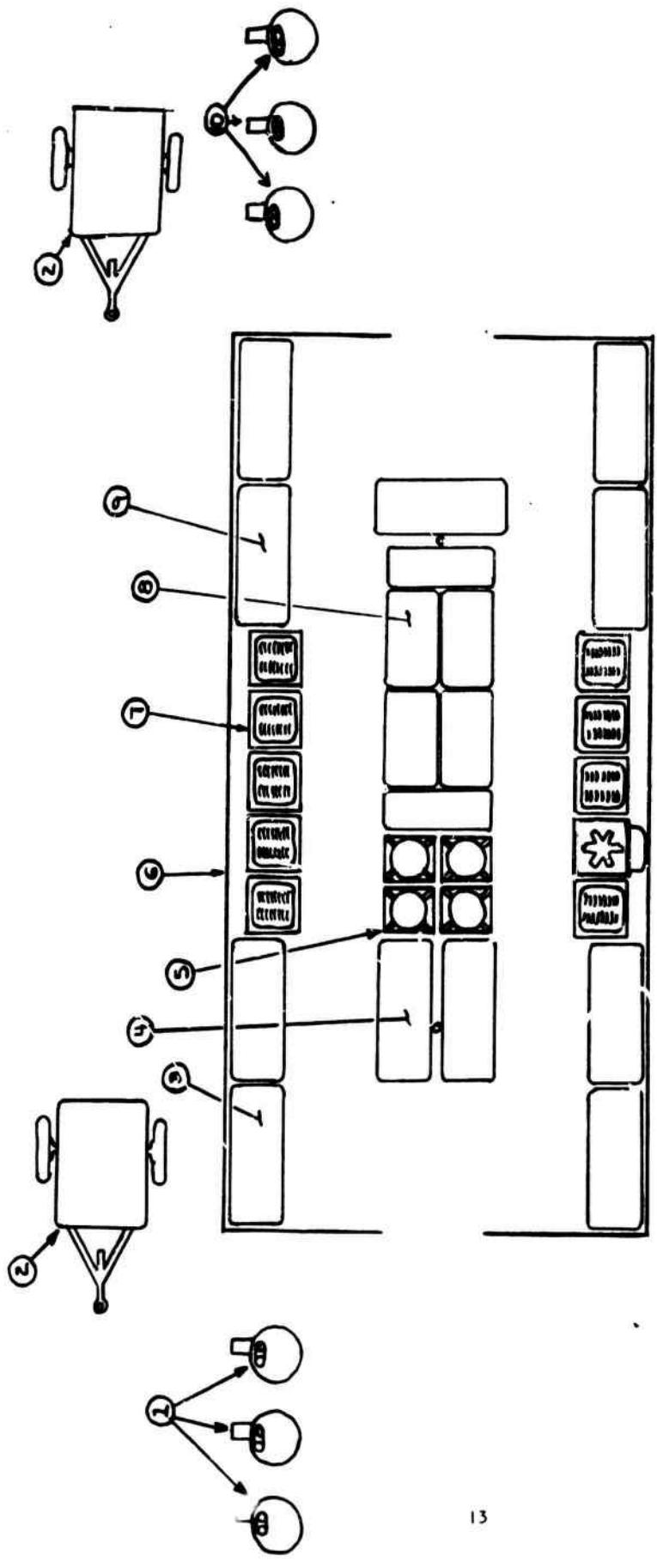


FIGURE 1
LAYOUT of M-1975 KITCHEN

- ① POT WASH LINE
- ② WATER TRAILER
- ③ COOKS STORAGE SHELVES
- ④ COOK'S WORK TABLE
- ⑤ COOK POT CROCK w/ BURNER
- ⑥ TENT, GP. MEDIUM
- ⑦ RANGE OUTFIT
- ⑧ CONTAINERIZING TABLE
- ⑨ PREPARED FOOD STORAGE SHELVES

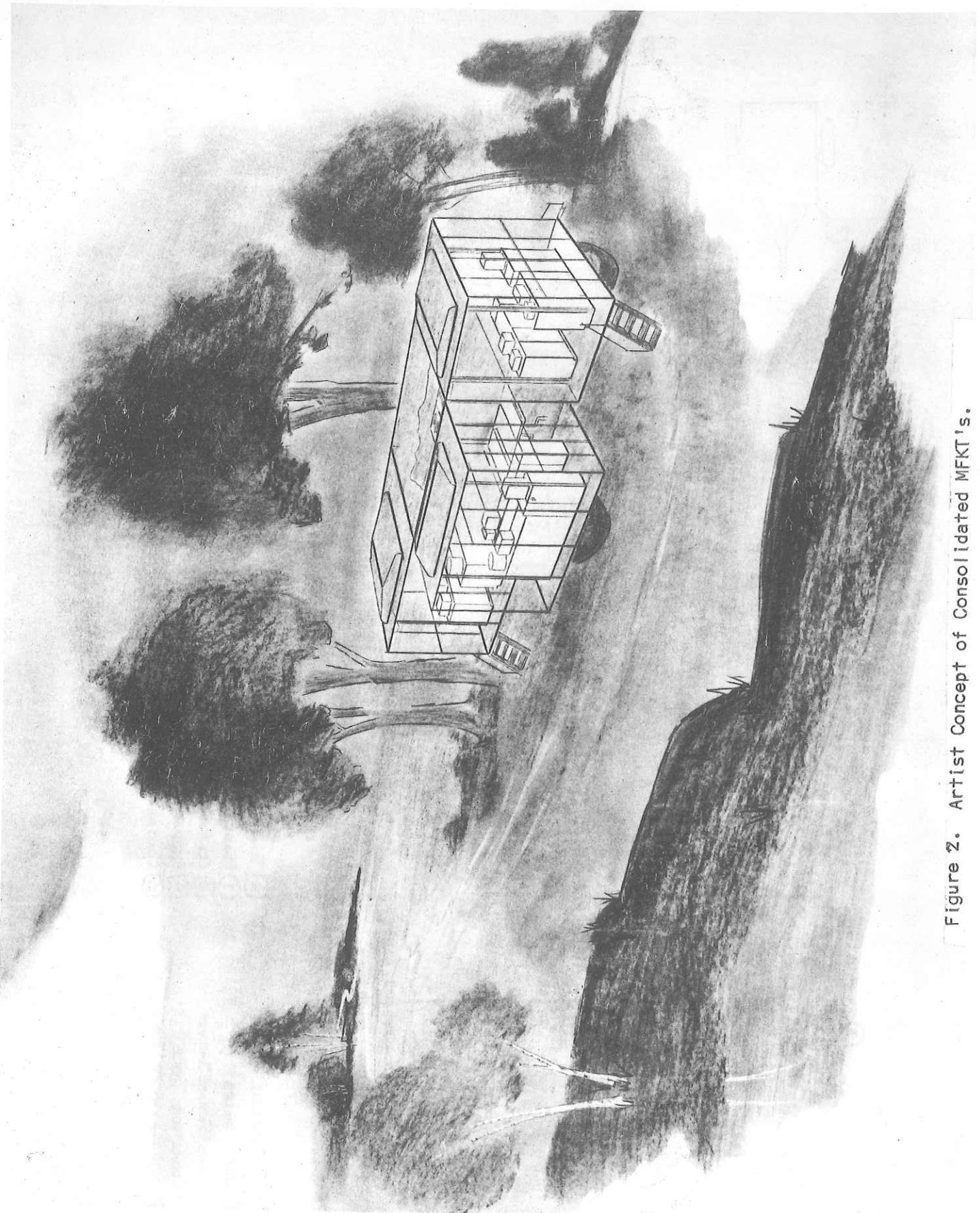


Figure 2. Artist Concept of Consolidated MFKT's.

Equipment - All systems utilize the standard range cabinet with M-2 burners, cooking pots with cradles, immersion heaters and water cans, and various utensils. Each kitchen also has one or more 2-1/2 ton trucks, 400-gallon water trailers and 1-1/2 ton cargo trailers, as required by the size of the kitchen. The kitchen is housed in either a tent or trailer depending upon the alternative. A detailed equipment list is contained in Appendix B.

Flow of Food

The flow of food is the same as the present system under all three alternatives, with one exception. In the current system, the kitchen generally assumes responsibility for the distribution and service of food to the troops. In the alternative systems, consolidated kitchens only distribute the food to a staging area (battalion combat trains), where it is picked up by the individual companies which assume responsibility for its final distribution and service. At the time of the next food pickup, the companies bring back the empty containers to the combat trains area where kitchen personnel assume responsibility for transport back to the kitchen for sanitation.

CHAPTER IV

THE FOOD SERVICE COMPANY

The concept of consolidation employed in this analysis is dependent upon two significant changes in the division food service organizational structure:

i. The addition of a field grade officer position (Major) to head up the division food service office and exercise staff supervision over the division's entire food service operation.

2. The creation of a food service company to assume responsibility for operation of the consolidated area kitchens.

Discussion - The proposed food service organization is designed to function with consolidation above the present company level kitchen. An organizational chart for this food service company is shown in Figure 3. This company will provide an effective means of feeding those widely dispersed divisional elements whose mission would make it unduly burdensome and inefficient to operate consolidated kitchens. Under this organization, a food service company will be assigned to each Supply and Transport Battalion, Support Command of Armored, Infantry, and Infantry (Mechanized) Divisions. The company headquarters consists of a headquarters section which provided command control and administrative support for the company, and an augmentation section which provides the necessary cooks and equipment to increase the feeding capacity of the HHC mess teams required by the plan for consolidation (Appendix A).

Two food service platoons, each consisting of a platoon headquarters and five area mess teams operate the ten area kitchens. These kitchens are to provide hot food to all divisional and non-divisional units within the division area who do not have an organic feeding capability.

Responsibilities - The food service company will be responsible for a number of activities which include:

1. Operating ten area kitchens in the brigade and division support areas, each capable of supplying 400 men with three hot meals per day.

2. Packaging prepared meals in appropriate containers (including insulated containers) for transport to the point of consumption.

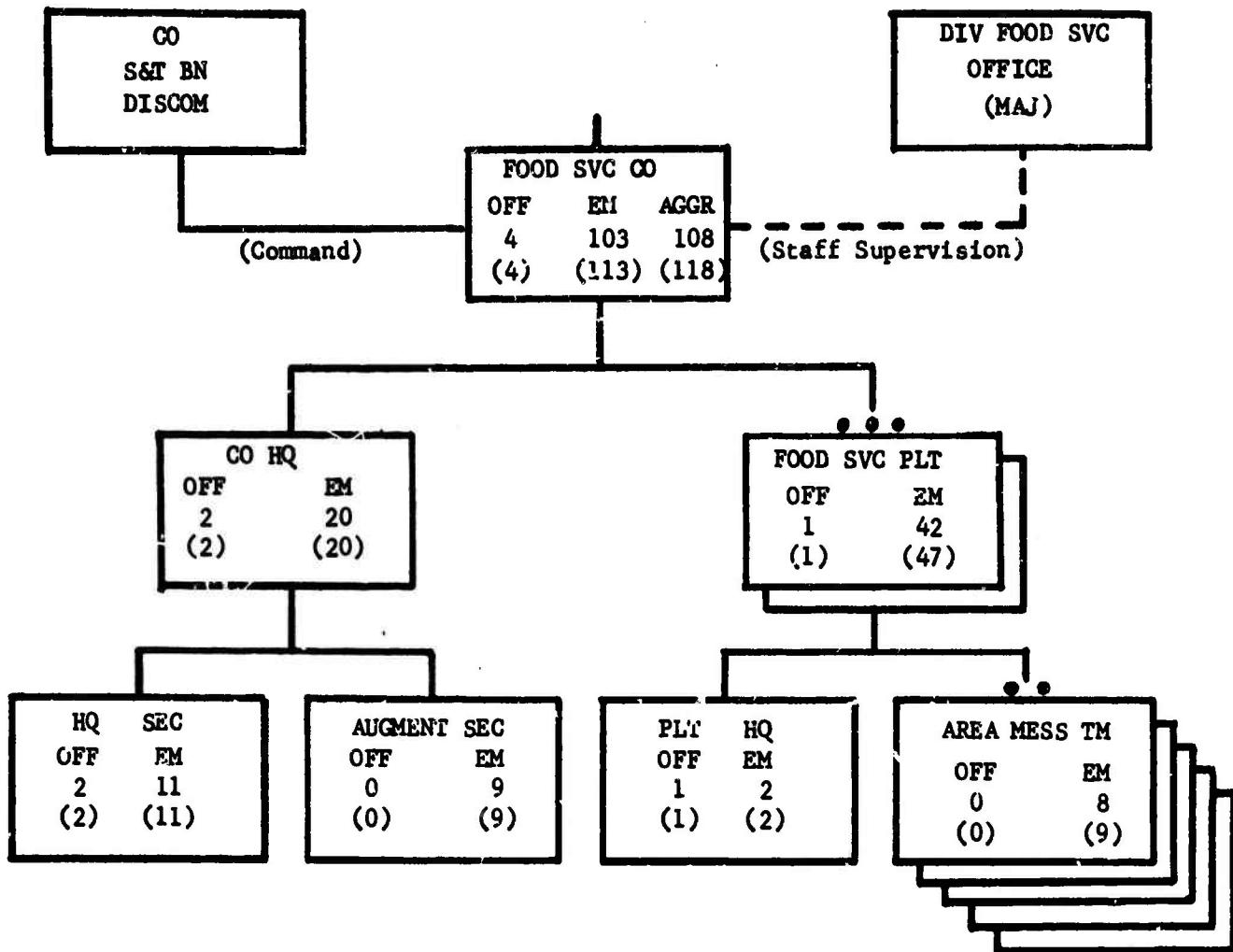
3. Issuing disposables, when used, and appropriate condiments.

4. Sanitizing shipping containers returned by supported units.

5. Augmenting designated headquarters messes with personnel and equipment.

6. Obtaining its own rations at the nearest Class I distribution point and water at the nearest water supply point.

7. Performing limited organizational maintenance on assigned vehicles, weapons and equipment.



Strengths shown in () are for units equipped with MFKT.

Figure 3 Food Service Company Organizational Chart

Concept of Operations - Based on guidance from the Division Food Service Officer, the Company Commander deploys the ten area mess teams in the most convenient and accessible locations for the units to be served. Whenever possible, the area kitchens should be co-located with other logistical activities such as brigade trains and major DISCOM installations. The general locations of the area kitchens could be a matter of standard practice to simplify the location problem for the kitchen as well as the customer. A schematic of one possible defensive deployment of the unit is shown in Figure 4.

The area kitchens issue prepared meals to units on request, and maintain simple, informal records accounting for the number of meals and any non-disposable containers issued to each unit. Units served by these kitchens will be required to return all non-disposable items prior to drawing their next meal.

Individuals or small groups may be fed directly from the kitchen at the discretion of the mess steward. Otherwise, the supported units are responsible for transport and distribution of the meals. The time period during which meals will be available for issue would be published in appropriate logistical orders and plans. The food service company is fully mobile in its own organic vehicles. A summary of personnel and major equipment requirements for the food service company is shown in Figure 5.

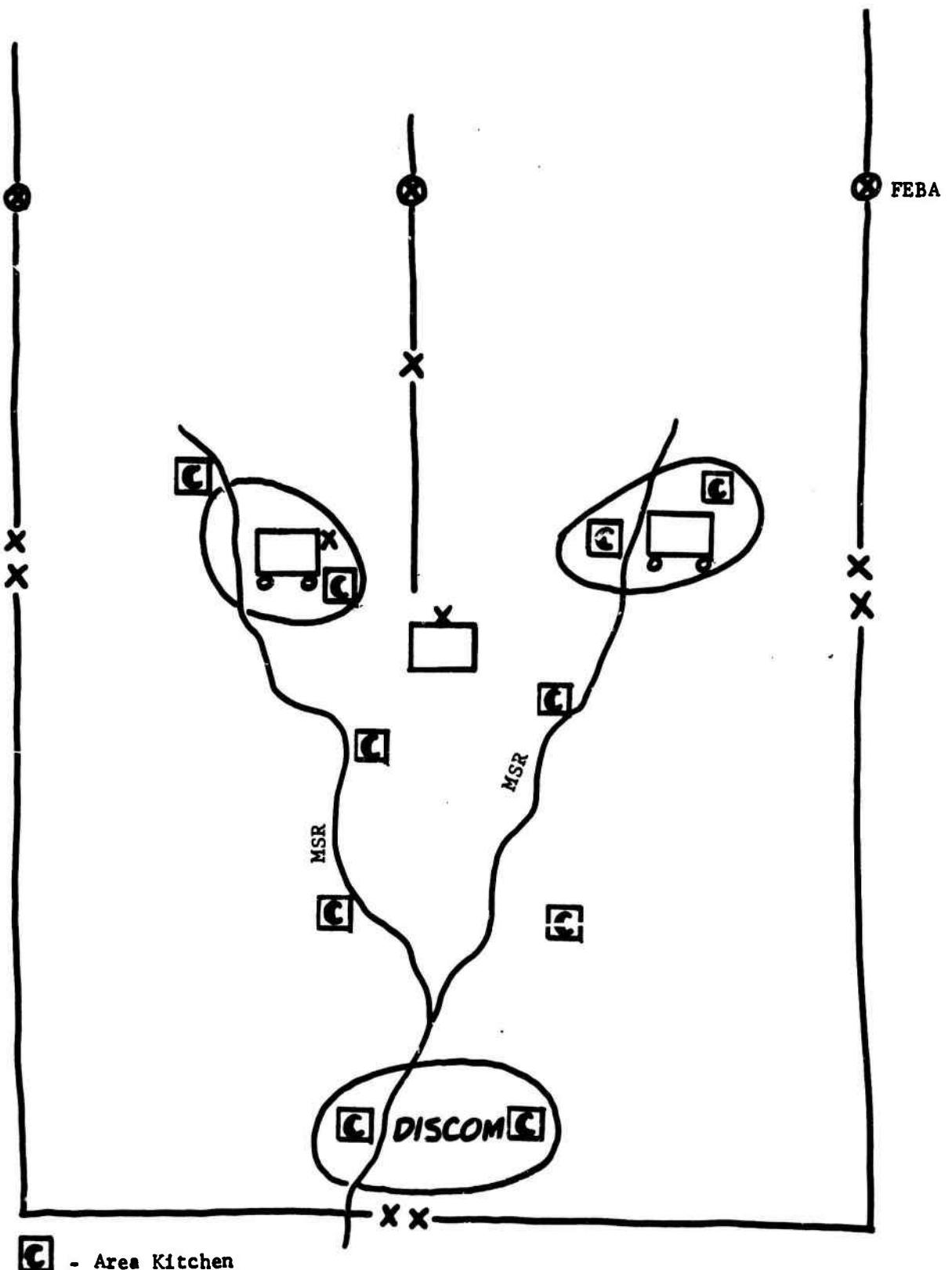


Figure 4

General Deployment Scheme for the
Divisional Food Service Company.

COMPANY HEADQUARTERS SECTION



1 CPT CO
1 E4 DVR/RTO



1 LT XO
1 E4 DVR/RTO



1 E8 1 SG
1 E4 CO CLK(DVR)



1 E6 MOTOR SGT
1 E4 WH VEH RPMN(DVR)



1 E5 SR WH VEH RPMN(DVR)



1 E6 SUPPLY SGT
1 E4 ARMORER (DVR)



1 E6 COMMD SGT
1 E4 FLD RADIO RPMN(DVR)

AUGMENTATION SECTION



9 E4 COOKS
(3 ALSO DVR)

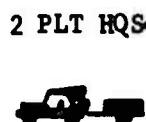


5 E4 COOKS
(2 ALSO DVR)



1 E6 1ST COOK
1 E5 2ND COOK
1 E4 COOK
1 E3 APPR COOK (DVR)

2 FOOD SERVICE PLATOONS



1 LT PLT LDR
1 E7 PLT SGT
1 E4 DVR/XTO

1 E7 SUPERVISOR
1 E6 1ST COOK
1 E5 2ND COOK
1 E3 APPR COOK(DVR)



1 E6 1ST COOK
1 E5 2ND COOK
2 E4 COOKS (DVR)

OR

10 MFKT MESS TEAMS



1 E7 SUPERVISOR
1 E6 1ST COOK
1 E5 2ND COOK
1 E4 COOK
2 E3 APPR COOKS (DVR)



1 E6 LST COOK
1 E5 2ND COOK
1 E4 COOK (DVR)

Figure 5 Food Service Company Personnel and Equipment Summary

CHAPTER V

MANPOWER REQUIREMENTS & PERFORMANCE OF PRESENT AND ALTERNATIVE SYSTEMS

Manpower Requirements for Alternatives

The staffing requirements for the three types of kitchens, (i.e., M-1959, M-1975 or MFKT) operating at various levels of feeding are detailed in Appendix C and were established using a combination of:

1. Work sampling data from Army and Marine Corps field exercises.
2. Data from Army and Marine Corps staffing guides and T.O.E.'s.
3. Data based on testing of developmental field kitchens.
4. Data from institutional sources.

Table 3 presents a summary of the food service manpower requirements (by grade) for the present field feeding system and the three alternative consolidated systems considered in this report. This summary of manpower requirements for the alternative systems is based on the plan of consolidation detailed in Appendix A, and the proposed staffing levels for the types of kitchens (i.e., tents or MFKT's) feeding at various levels which are detailed in Appendix C.

As can be seen from Table 3, the total manpower requirement for alternative 2 is less than that for alternatives 1 or 3. This is because alternative 2 employs the MFKT to feed at the lower levels (up to 349), and this kitchen is more efficient at the lower levels than using the M-1959 kitchen tent. Also, the M-1975 tent which has been proposed for use at higher levels is generally more efficient than using 2 or 3 MFKT's. Alternative 1 is slightly less efficient than alternative 2 because it also utilizes kitchen tents at the lower feeding levels which are less efficient than MFKT's at these levels. Alternative 3, which utilizes MFKT's at all levels, is slightly less efficient than either of the two other alternatives. This is due to the fact that a kitchen operating out of a tent can be easily tailored by the addition or deletion of a cook or a range as the number of people subsisting from the kitchen changes. However, when the capacity of the MFKT(s) being utilized is exceeded, an entire additional MFKT along with its appropriate staffing is required resulting in the inefficient use of the additional MFKT and manpower.

Referring to the Options shown in Table 3, the differences in staffing between Options A and B reflect the increased manpower requirements for the operation and maintenance of the mess kit laundry lines required with Option A for proper sanitation of mess kits. Option B, which utilizes a disposable tray and utensils does not require a mess kit laundry line. Option C, which utilizes disposable trays, utensils and disposable food containers further reduces the manpower requirements of Option B. However, the additional reduction in the sanitation workload associated with Option C is not considered significant enough for the smaller kitchens to produce the savings of an additional attendant. Nevertheless, Option C does produce a saving of one additional attendant for kitchens with 650 or more troops assigned.

TABLE 3
 FOOD SERVICE STAFFING REQUIREMENTS FOR PRESENT AND ALTERNATIVE
 CONSOLIDATED SYSTEMS BY GRADE (4Divisions)

Grade	Present	Alternative		
		1	2	3
04	0	4	4	4
03	4	8	8	8
02	4	16	16	16
W02	20	20	20	20
E8	4	8	8	8
E7	441	209	209	209
E6	425	294	294	325
E5	838	320	289	293
E4	626	371	367	365
E3	---	191	191	232
TOTAL	2362	1441	1406	1480

Option A:

Attendants	1725	1104	1104	1104
TOTAL	4087	2545	2510	2584

Option B:

Attendants	---	733	733	733
TOTAL		2174	2139	2213

Option C:

Attendants	---	689	689	689
TOTAL		2130	2095	2169

In computing productivity, it is assumed that all personnel work a 12-hour day, seven days per week. The number of consumers is 64,223 which is the strength of all four divisions.

Figure 6 shows that the productivity for the present system is 3.9 meals per man-hour. By comparison, productivity for any of the three alternatives is significantly increased. For example, worker productivity for Alternative 1A is 6.3 meals per man-hour, a 62% increase over the present system.

Again referring to Figure 6, it can be seen that options within alternatives follow a similar pattern from one alternative to another and all of these alternatives/options result in significant productivity increases over the present system. The productivity in meals per man-hour for Alternative 2, a combination of MFKT's for small units and tents for large units, is slightly higher than that for Alternative 1 (all tents) or Alternative 3 (all MFKT's) regardless of the option. Since all three alternative systems are based on the same plan for consolidation of the divisional unit, Figure 6 suggests that the type of kitchens authorized, tent or MFKT, has only a marginal effect on a system's productivity, while the options within alternatives, (i.e., whether or not disposables are used) have a much greater effect on the system's productivity.

Alternative System Productivity

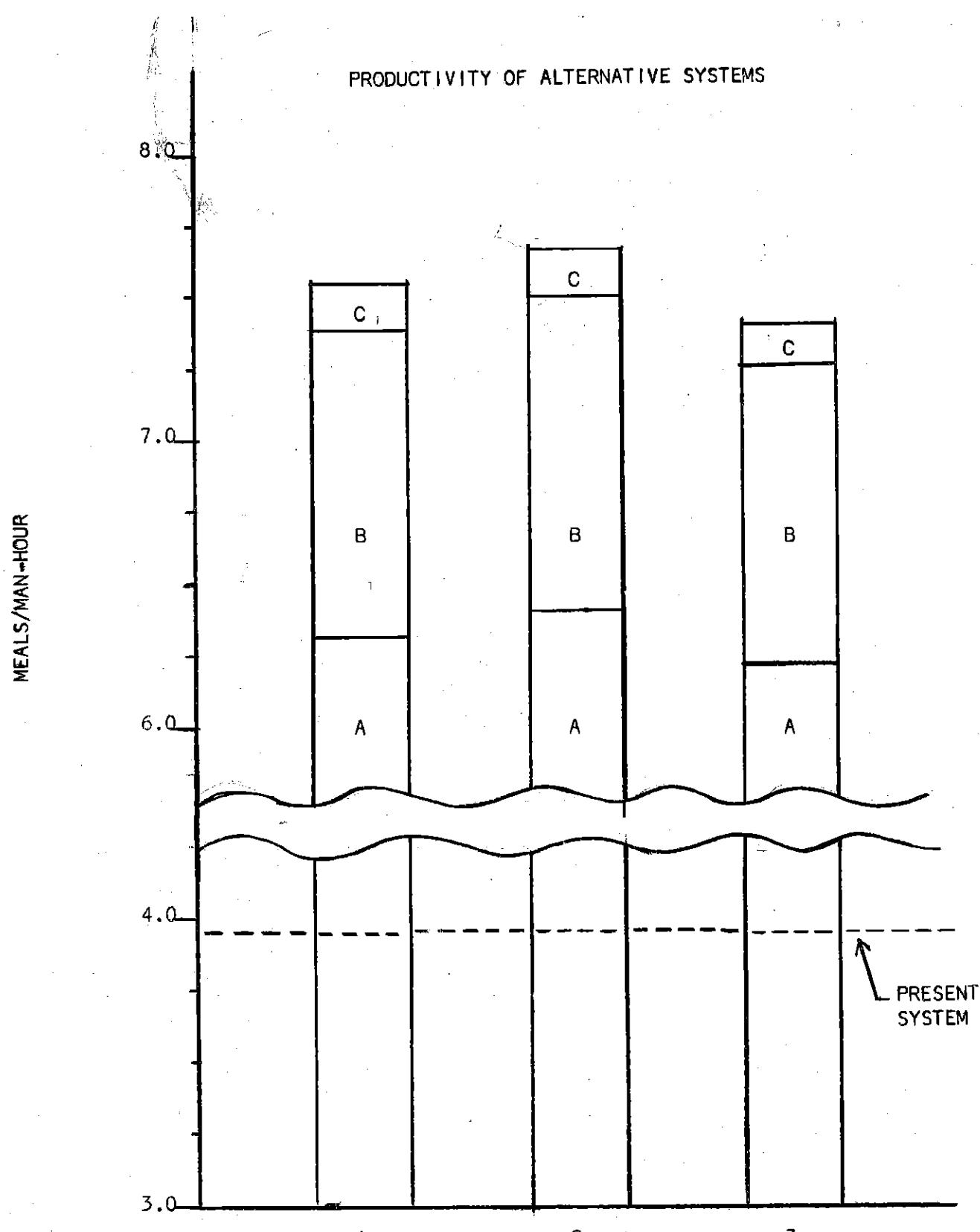
A good measure of a feeding system's performance is the number of meals produced per man-hour of time expended (system productivity). The productivity of a feeding system is dependent upon many variables such as: menu, condition of food (prepared or raw ingredients), types of service being offered, system capacity, and type and layout of equipment, etc. Taking all these factors into consideration for the existing system and the alternative systems, system productivities were computed and are shown in Figure 6. This figure consists of a bar graph depicting the productivity in meals per man-hour for the existing system and each of the three alternative systems with Options A, B, and C. Productivity for the existing system is shown as a line at the bottom of the graph. Each bar graph for the alternative systems is based on the manpower requirements for alternatives and options which are detailed in Table 3. These manpower savings include all personnel with a food service MOS, all attendants, and all personnel assigned to the Food Service Company.

Figure 7 presents a graph on a kitchen productivity in meals per man-hour as a function of kitchen size. Plotted is the productivity for kitchens with tents and also for MFKT's. As can be seen from Figure 7, productivity increases rapidly as kitchen size increases from company level (100-200) to some higher level (600-800) at which point further gains in productivity accrue at a decreasing rate suggesting that consolidation above the battalion level would not produce any additional significant manpower savings with existing equipment.

Alternative System Manpower Savings

The manpower requirements of the various alternative systems are greatly reduced as compared to the present system. The extent of these savings is presented in Table 4. Food service personnel savings range from 956 with Alternative 2, a 40% reduction, to 882 with Alternative 3, a 37% reduction.

PRODUCTIVITY OF ALTERNATIVE SYSTEMS



ALTERNATIVE
FIGURE 6

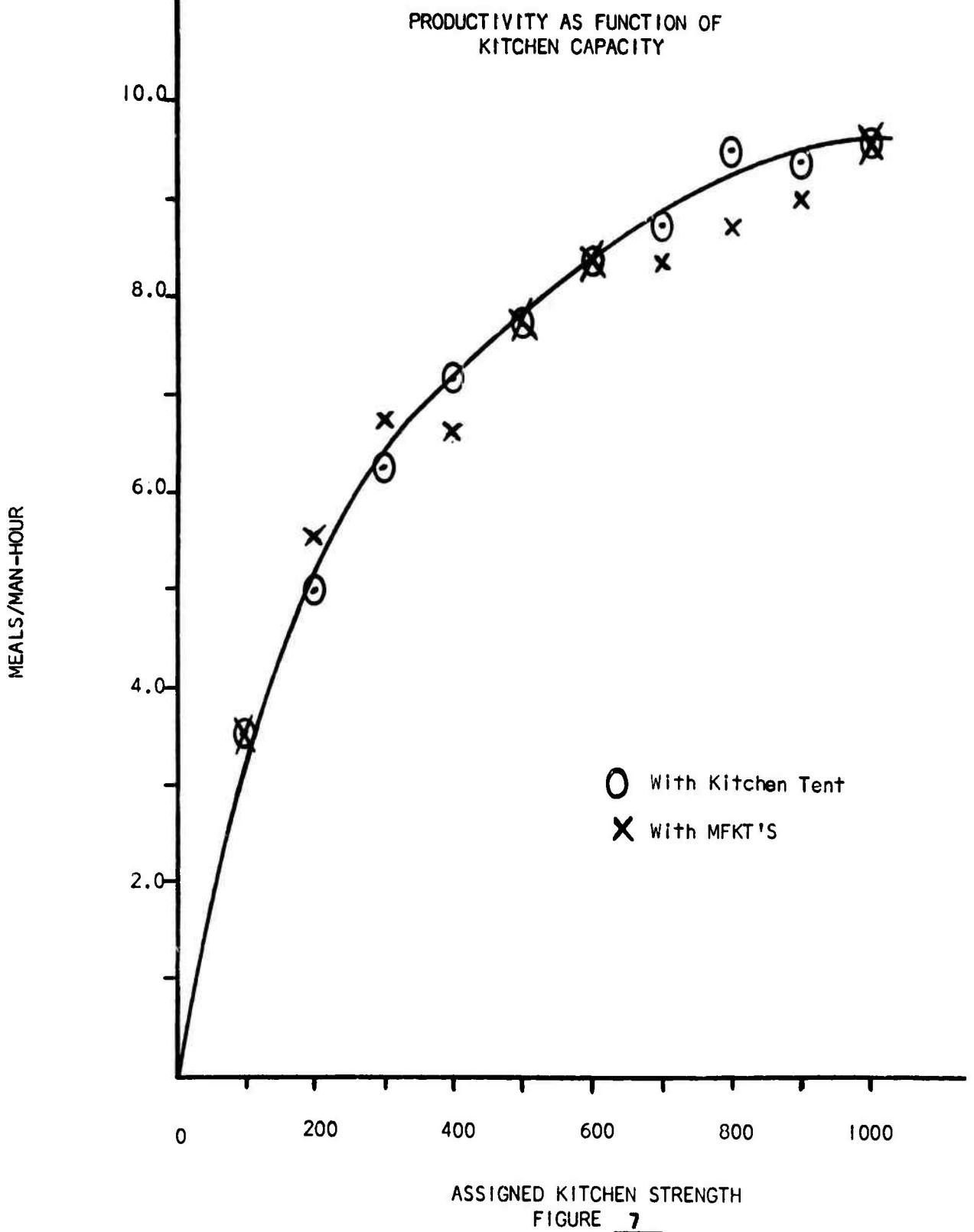


TABLE 4
SYSTEM MANPOWER SAVINGS COMPARED TO PRESENT SYSTEM

		<u>Alternatives</u>		
		1	2	3
Food Service Pers.		921 (39%)	956 (40%)	882 (37%)
A				
Kitchen Attendants	621 (36%)	621 (36%)	621 (36%)	
TOTAL	1542 (38%)	1577 (38%)	1503 (37%)	
B				
Options	Kitchen Attendants	992 (58%)	992 (58%)	992 (58%)
	TOTAL	1913 (47%)	1948 (48%)	1874 (46%)
C				
	Kitchen Attendants	1036 (60%)	1036 (60%)	1036 (60%)
	TOTAL	1957 (48%)	1992 (49%)	1918 (47%)

Reductions in kitchen attendants are even greater, ranging from 1036, a 60% savings, with Option C to 621 for Option A, a 36% savings. Even though kitchen attendants cannot be cut from the T.O.E., the reduced requirement for their services would be expected to improve the combat effectiveness of divisional units.

CHAPTER VI

EVALUATION OF ALTERNATIVE SYSTEMS

There were two major factors considered in this evaluation: (a) total system cost and (b) system effectiveness. Any field feeding system offered as an alternative to the existing system must be cost effective in addition to meeting specific performance (effectiveness) criteria. Therefore, each of the alternative systems is designed to insure that the level of effectiveness in furnishing hot, acceptable meals is at least equal to that of the existing system.

In the economic analysis performed herein, the total annual cost of providing food service to the four divisions (in a European scenario) was completed using well-known techniques. Total costs for each alternative and option were then compared to the total costs for the existing system to determine cost effectiveness.

To insure that all important factors of systems effectiveness are considered and quantitatively rated in this evaluation, the performance characteristics of each alternative system are quantified, weighted as to relative importance, and then compared to those of the present system. By this method, an overall system's effectiveness rating is developed for each alternative. It is noted that the subjective weightings given to the various system effectiveness factors are based upon the experience and best judgment of the authors. The reader is encouraged to use his own best judgment, establish his own weightings and re-calculate the effectiveness ratings.

ECONOMIC ANALYSIS

Methodology

There are several accepted techniques for analyzing and comparing the financial aspects of alternative systems. These include the payback period, uniform annual cost, net present worth, and rate of return methods. The uniform annual cost method is preferred in evaluating proposed alternatives to existing military systems.¹ Hence, this procedure will be used in this economic analysis.

The uniform annual cost procedure combines the investments and recurring annual costs associated with each alternative into an equivalent single annual expenditure by considering the time value of money and the use of capital recovery factors over the total economic life of the project.²

¹ AR 37-13 "Economic Analysis and Program Evaluation of Resource Management," HQ, Dept of the Army, Washington, D.C., April 1973.

² Grant, E.L. and Ireson, W.G., "Principles of Engineering Economy," The Ronald Press Co., New York, N.Y., 1964.

Assumptions

Certain assumptions are required in the performance of an economic analysis. In this analysis these assumptions are:

1. The age of the equipment presently being used in the existing system is homogeneous (i.e., some items are brand new, while others approaching wearout are about to be replaced with the remainder equally distributed between these extremes). Thus, the annual investment expenditure for replacement equipment in the present system is given by the ratio C/L where C is the cost of the equipment in dollars and L is its economic life in years.
2. The analysis includes all system costs incurred during 12 months of operation.
3. The discount rate used is 10%.
4. Salaries, benefits, and all other costs remain constant over the period of analysis.
5. Troop strengths remain constant over the period of analysis.
6. The menu selected is assumed to remain the same for all alternatives. Thus food costs remain constant and do not affect the outcome of the analysis.

System Cost Elements

For purposes of this analysis, the food service system costs are comprised of the following components.

Food Costs:

Food costs are the same for all alternatives and are calculated on a mix of 77% "A" and "B" rations, and 23% operational rations. An assumption here is that "B" rations will be used during the initial month and then replaced with "A" rations for the remainder of the operation. Food costs are based on December, 1974, prices.

Labor Costs:

There are five factors which comprise the total cost to the military for maintaining a soldier. These are:

1. Salary and benefits;
2. Support costs (medical, subsistence, clothing allowances, etc.);
3. Training costs;
4. Rotation costs; and
5. Initial clothing and accession costs.

To use the methodology described earlier, each of these factors must be converted into a uniform annual cost. Appendix D shows the detailed calculations that yield the uniform annual costs for each pay grade.

It is important to note that salaries and benefits account for only 58% (max) of the total cost for food service personnel and 62% of the total cost for kitchen attendants.

Labor requirements for the present system, as described in Chapter V, are based on the 441 kitchens for the four divisions. The labor costs were computed using the manpower requirements detailed in Chapter V and the personnel costs cited in Appendix D.

Food service personnel requirements for the alternative systems are based on consolidating to 197 kitchens.

Equipment Costs:

In the present system, equipment costs are calculated on the assumption of homogeneity of age for the equipment presently in existence, as stated in the assumptions.

For the alternative systems equipment costs are divided into two categories, equipment presently in the system and new equipment. Initial new equipment expenditures for the different alternatives are given as follows:

<u>Alternative</u>	<u>New Equipment</u>	<u>Cost (\$)</u>
1	44 - M-1975 Tents	88,000.
2	44 - M-1975 Tents, 109-MFKT's	960,000.
3	313-MFKT's	2,504,000.

New equipment costs are calculated using a capital recovery factor for the estimated life of the equipment. The calculation of the cost for present equipment depended upon the assumption of homogeneity of age in determining annual costs.

Fuel Costs:

In the present system, fuel costs are based on the fuel consumption of an average size kitchen (146 troops). They have been adjusted to reflect reduced consumption for the period of time that the troops are subsisting on individual operational rations. The cost per gallon is the current price of the fuel delivered in Europe. For the alternative systems, fuel costs are determined based on an average kitchen size of 326 troops and the extent to which disposables are introduced into the system.

Water Costs:

Water consumption is based on the same kitchen size for each of the alternatives as used in fuel cost calculations (i.e., 146 troops in the present system, 326 troops in the alternative systems) and the extent to which disposables are employed. The cost per gallon is calculated on the labor costs of the troop units producing the water.

Transportation Costs:

Transportation costs per ration were obtained from an analysis of the existing system.¹ These include shipping the food from the U.S. through port of entry to the rear depot. From there, semi-trailers deliver it to the brigade trains. This cost includes transportation from the U.S. to the brigade trains.

The cost to transport food remains the same for all alternatives. Disposable transportation costs are added in Options B & C.

Disposable Costs:

There are no disposables used in the existing system. In the alternative systems, Option B includes a disposable tray and utensils. For Option C, disposable insulated food containers are added.

Results and Analysis

In reviewing the figures in Table 5, several points must be emphasized. There are, in effect, two separate analyses being performed. The first analysis consists of three different kitchen configuration-alternatives (i.e., tents, combinations of tents and trailers, all trailers) for the proposed concept of consolidation previously discussed in Chapter III.

The second analysis concerns itself with the application of disposables at different levels and the resulting savings of kitchen attendants as more disposable items are introduced into the system.

Option A in each alternative represents the first analysis mentioned above and Options B and C the second. In reaching a conclusion, one must first select the most desirable alternative compared to the present system (either 1A, 2A, or 3A) and then evaluate if the alternative is further enhanced by the introduction of disposables (Options B & C).

Table 5 shows the uniform annual costs for each of the alternatives and the present system. The associated labor costs needed to support these alternatives are also presented with the resulting savings in comparison to the present system. Explanations of the individual component costs are given in the following sections of this report with detailed derivations presented in Appendices D, E. and F.

¹ Bonczyk, T.S., et. al., "An Analysis of the Present Army Field Feeding System," NLABS Technical Report to be published in April 1975.

TABLE 5
COMPARISON OF TOTAL UNIFORM ANNUAL FOOD SERVICE SYSTEM COSTS (Thousands of Dollars)

Cost Components	Present System	Alternative 1-A	Alternative 1-B	Alternative 1-C	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 3-A	Alternative 3-B	Alternative 3-C
		\$64,933	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933
Food	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933	\$64,933
Labor	50,680	31,096	27,462	27,031	30,628	26,994	26,563	31,588	27,953	27,522
Equipment	1,242	1,080	1,066	1,035	1,157	1,143	1,112	1,496	1,482	1,451
Fuel	3,900	3,339	1,350	1,226	3,339	1,350	1,226	3,339	1,350	1,226
Water	1,155	1,074	729	648	1,074	729	648	1,074	729	648
Transportation	8,603	8,603	9,198	15,081	8,603	9,198	15,081	8,603	9,198	15,081
Disposables	0	0	4,014	21,660	0	4,014	21,660	0	4,014	21,660
Total Annual Cost	\$130,513	\$110,125	\$108,752	\$131,614	\$109,734	\$108,361	\$131,223	\$111,033	\$109,659	\$132,521
Cost/Ration (dollars)	5.57	4.70	4.64	5.61	4.68	4.62	5.60	4.74	4.68	5.65
Total Savings over Present System	N/A	20,388	21,761	(1101)	20,779	22,152	(710)	19,480	20,854	(2008)
Savings in Kitchen Attendants	N/A	6,083	9,718	10,149	6,083	9,718	10,149	6,083	9,718	10,149
Net Savings ¹ (Increase) over Present System	N/A	14,305	12,043	(11,250)	14,696	12,434	(10,859)	13,397	11,136	(11,157)
No. of Food Service Pers	2362	1441	1441	1441	1406	1406	1406	1480	1480	1480
No. of Kitchen Attendants	1725	1104	733	689	1104	733	689	1104	733	689
Total Personnel	4087	2545	2174	2130	2510	2139	2095	2584	2213	2169

¹ Assumes no cost savings can be claimed for reduced kitchen attendants.

The following observations are made based on the results shown in Table 5:

1. Differences in dollar savings between alternatives with the same option are negligible while differences between options within an alternative are substantial. The inference here is that the choice of option is far more critical than the choice of alternative.
2. All the alternative systems utilizing options A or B provide substantial savings in annual operating costs when compared to the present system. These savings range from a high of \$22.15 million to \$19.48 million. Those alternative systems utilizing option C actually result in cost increases ranging from \$0.71 million to \$2.01 million.
3. If kitchen attendant labor costs are excluded, Alternative 2-A provides the greatest cost savings, \$14.70 million annually.

SYSTEMS EFFECTIVENESS

Methodology

An analysis was performed to determine the overall effectiveness of each of the nine alternative/options. This analysis is based on the extent to which each meets the following performance characteristics, as compared to the present system:

Manpower Requirements - includes the total number of food service personnel and kitchen attendants required by each system.

Annual System Cost - total annual cost, including personnel costs, material costs, transportation costs, and the cost of food and other consumables.

Logistical Impact - effect of increased or decreased demand on cargo lift and storage facilities.

Mobility - cross-country mobility; capability to keep up with the supported units and still deliver the product. Includes the time, effort, and equipment required to sanitize individual mess kits for Option A.

Food Quality (Acceptance) - the capability of the system to maintain prepared food in an acceptable condition throughout the transport and delivery phase.

Convenience to Consumer - the distance the soldier walks to the feeding site. The need for the soldier to return to this site to wash his mess kit.

Sanitation Requirements - the overall sanitation workload including individual mess kits (where required), as well as all kitchen equipment, utensils and pots and pans.

Tactical Compatibility - effect on unit's light, noise and camouflage discipline. Capability to deliver as close as possible to tactically disposed elements with minimum degradation of their combat effectiveness.

Fuel and Water Consumption - amounts of fuel and water required daily for proper operation of each system.

Initial Capital Expenditure - procurement cost of new equipment, including the MFKT.

Considering each of the above characteristics, a numerical value was then assigned to each system based on the following relationship to the present system:

- 2 - Significant advantage over present system.
- 1 - Moderate advantage over present system.
- 0 - No significant difference from present system.
- (1) - Moderate disadvantage over present system.
- (2) - Significant disadvantage over present system.

NOTE: Values in parentheses are negative.

All assigned values were then weighted by a factor of 1 to 3 depending on the relative importance given to each characteristic:

- 1 - Minor importance.
- 2 - Major importance.
- 3 - Overriding importance.

The weighted values were then computed by multiplying the numerical performance value by the relative weight to obtain the results shown in Table 6. For example, the value for Factor A of Alternative 1, Option C, is obtained by assigning a numerical performance value of 2 and a weight of 3. The product of these two values yields the resultant weighted performance value of 6.

Discussion

The following discussion of results is based on the comparisons of alternative systems presented in Table 6 and shown in Figure 8.

TABLE 6. WEIGHTED COMPARISONS OF PERFORMANCE CHARACTERISTICS
OF ALTERNATIVE SYSTEMS TO PRESENT SYSTEM

		<u>Alternatives</u>								
<u>Factor</u>	<u>Weight</u>	1			2			3		
		A	B	C	A	B	C	A	B	C
A	3	3	6	6	3	6	6	3	6	6
B	3	3	6	0	3	6	0	3	6	0
C	3	0	0	(6)	0	0	(6)	0	0	(6)
D	2	(2)	0	0	2	4	4	2	4	4
E	2	0	0	4	0	0	4	0	0	4
F	2	0	2	4	0	2	4	0	2	4
G	2	0	2	4	0	2	4	0	2	4
H	2	(2)	0	2	0	2	4	0	2	4
I	1	0	1	2	(1)	1	2	0	1	2
J	1	0	0	0	0	(1)	(1)	(2)	(2)	(2)
System Effectiveness		2	17	16	7	22	21	6	21	20

Key:

- | | |
|-------------------------------|---------------------------------|
| A - Manpower Requirements | G - Sanitation Requirements |
| B - Annual System Cost | H - Tactical Compatibility |
| C - Logistical Impact | I - Fuel and Water Consumption |
| D - Mobility | J - Initial Capital Expenditure |
| E - Food Quality (Acceptance) | |
| F - Convenience to Consumer | |

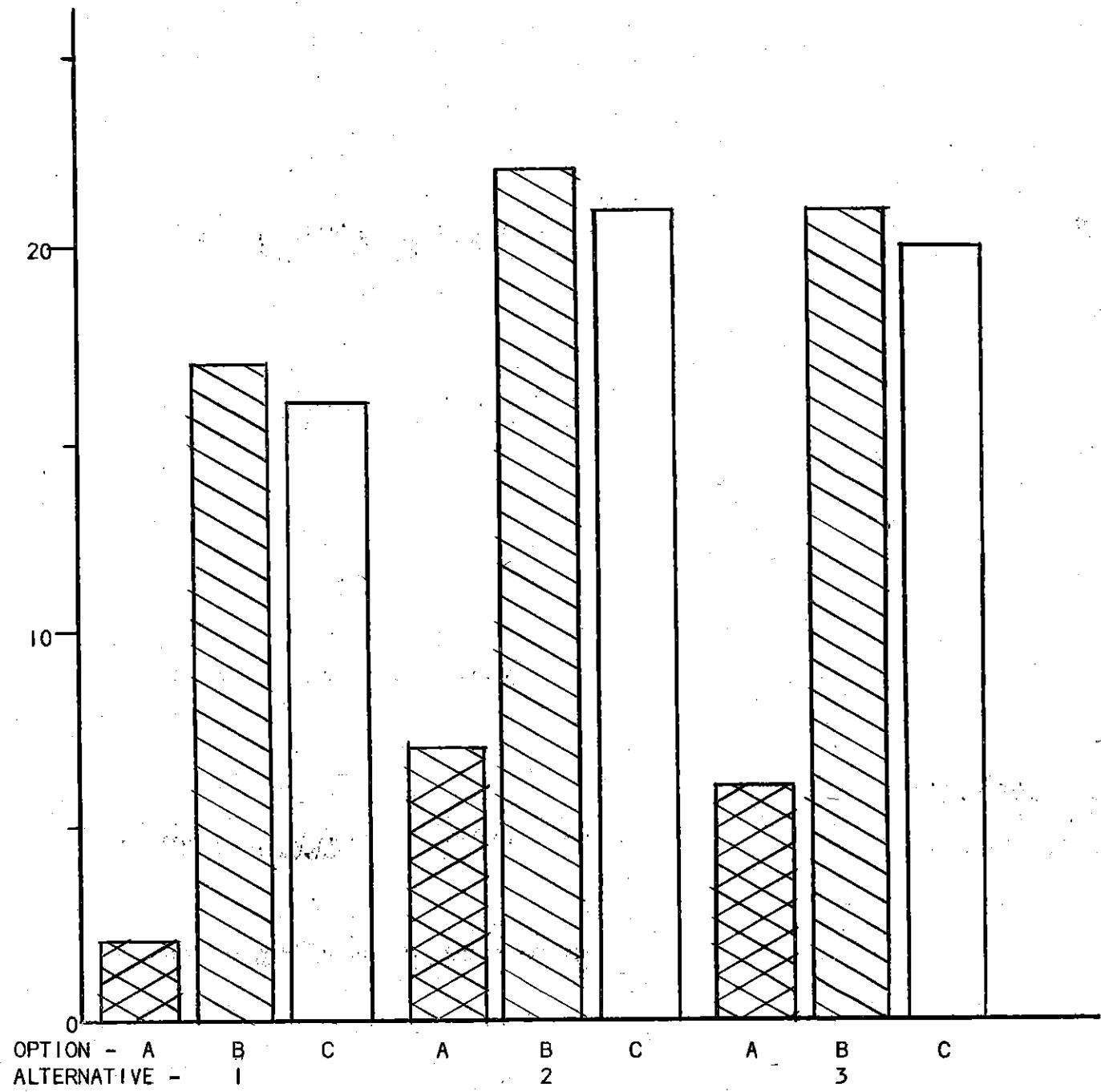


Figure 8. Relative Effectiveness of Alternative Systems
Compared to Present System (base line).

Alternative 1 - Alternative 1 offers a cost advantage in that it requires no capital outlay for new equipment (i.e., MFKT). Its total reliance on tents, however, restricts the mobility of the system. Additionally, the larger concentrations of vehicles and equipment characteristic of the larger consolidated kitchens could constitute a significant tactical disadvantage under some combat conditions.

Alternative 2 - This alternative offers the best compromise between operational efficiency and mobility by capitalizing on the advantages of using MFKT's for smaller kitchens and tents for the larger kitchens. It also facilitates orderly phased introduction of the MFKT into the system, with concurrent redistribution of excess field kitchen equipment.

Alternative 3 - Aside from optimum mobility, this alternative offers no other advantages over alternative 2. It requires considerably greater capital investment, and is slightly less cost effective than the other alternatives.

Option A - Since Option A represents the present method of sanitation and final distribution of prepared food operating within a consolidated concept, the only advantages to be gained are those resulting from the consolidation plan itself. Since this Option retains a major deficiency of the present system, namely the mess kit laundry line, it consistently scores low regardless of alternative. This failure played a major role in evaluating most of the measures of effectiveness used, resulting in the very low system effectiveness score.

Option B - This Option offers the most significant improvement over the present system for each of the 3 alternatives. The high ratings of this option are due primarily to the elimination of the mess kit laundry problem and the fact that this Option shows no overriding disadvantages.

Option C - Option C was rated second overall in combination with each of the alternatives and represents a significant improvement over the present system. The use of expendable containers offers improved food acceptance and convenience, reduces sanitation requirements and minimizes interference with the units combat readiness. Nevertheless, the disposable food containers place an overriding burden on the logistical system and considerably increase the systems operating cost.

The Preferred System(s)

One of the primary purposes of this analysis was to determine the manpower savings that would result from consolidating the Army's present company level kitchens into kitchens at some higher level. A careful analysis of each divisional unit's mission, functions, location and concepts of operation was performed in determining whether the unit should maintain its own company level kitchen or be fed by some higher level consolidated kitchen.

Within the plan for consolidation, it was decided to analyze three potential alternative systems, Alternative 1 was comprised entirely of kitchens with tents, Alternative 3 was comprised entirely of MFKT's while Alternative 2 was comprised of MFKT for small kitchens and tents for the larger kitchens. Within each alternative, it was also decided to analyze three options: Option A was based on the utilization of the present mess kit, Option B utilized disposable trays and utensils, while Option C was the same as B but introduced disposable insulated food containers.

The manpower savings from consolidation for Option A was significant and approximately the same for all three alternatives. Further, significant savings in kitchen attendants is possible with Option B. A small additional reduction in kitchen attendants is gained by employing Option C with any of

TABLE 7

PERFORMANCE COMPARISON OF PRESENT SYSTEM AND ALTERNATIVE SYSTEMS WITH OPTION B

	Present	ALT 1	ALT 2	ALT 3
F.S. Personnel Req	2362	1441	1406	1480
Attendant Req	1725 ¹	733	733	733
Total Annual Savings (\$1,000) ²	----	21,761	22,152	20,854
Systems Effectiveness	----	17	22	21
Capital Investment Req (\$)	----	88,000	960,000	2,504,000

¹ Present system is based on Option A

² Compared to total annual cost of present system \$130,513,000

the three alternatives. However, Option C greatly reduces the total savings in annual operating costs because of the cost of disposable food containers. The small additional savings in manpower can only be obtained through a much higher total system operating cost (compared to Option B).

This comparison suggests that Option B is superior when considering manpower, cost and overall effectiveness. By referring to Table 7, it can be seen that the improvements resulting from the combination of Option B with any of the three alternatives is basically the same. Therefore, the authors consider that the preferred system can be selected from any of the three systems, (1B, 2B, and 3B), although 2B overall is slightly superior to either 1B or 3B. Nevertheless, the differences in manpower and cost are considered small enough that a decision should be based on systems effectiveness characteristics. It is re-emphasized here that the characteristics and weighting of Table 6 represented the best collective judgement of the authors. However, the decision maker may attach still different weights to these characteristics which could change the results.

CHAPTER VII

CONCLUSIONS & RECOMMENDATIONS

Conclusions:

1. Consolidation of the Army food service activities in the field is potentially feasible and does offer substantial savings both in manpower and costs.

2. Due to mission requirements and location, a variety of kitchen sizes are required for consolidation to be effective. These range from the company size kitchen, feeding as few as 100 troops, to the battalion kitchen feeding nearly 1000 troops.

3. The choice of alternatives (type of kitchen) does not greatly affect performance or cost. Mobility is significantly increased, however, with the introduction of MFKT's.

4. The system of food service identified as Alternative 2, (combination of MFKT's and M-1975 consolidated tent kitchens) Option B (disposables) offers the best mix of advantages:

a. Total potential cost reduction for providing food service for the four division force is \$22.15 million annually.

b. Net potential reduction in annual costs (excluding cost savings associated with a reduced kitchen attendant requirement) is \$1.70 million annually.

c. Reduction of food service personnel for the four division force is 956.

d. Kitchen attendant requirements are reduced by 992 personnel.

e. Mobility of the food service system is increased by introduction of the MFKT for those units that need company size kitchens.

The savings in kitchen attendants, while producing actual reductions in the labor costs chargeable to the food service system, will not result in a reduction of a unit's authorized strength, since this is usually an additional duty function. Therefore, even though the cost of food service is reduced by decreasing these requirements, divisional manpower costs will not be reduced by an equivalent amount. However, kitchen attendant savings does increase divisional combat effectiveness by allowing personnel who are no longer required for such duty to perform their primary combat tasks. As mentioned above, in Alternative 2, Option B, this allows an equivalent of 992 personnel to return to their units and primary combat duties. While it is difficult to attach a dollar value to this increased unit effectiveness, it is conceivable that the benefit to the four division force is of much greater value than the savings in dollars if the kitchen attendant personnel spaces could actually be eliminated.

Discussion & Recommendations:

This analysis has been based upon many complicated factors including, but not limited to:

1. Comprehensive analysis of the combat mission requirements of the four division force.
2. Extensive experience in determining labor requirements for food preparation and distribution systems gained in food service systems analysis.
3. Realistic evaluation of existing field equipment capabilities in the preparation of and distribution of a reasonable mix of individual combat rations, B rations, and A rations for a four division force engaged in combat operations in Europe.

It should be emphasized that the authors consider it essential for the reader to view this report as a detailed theoretical analysis. Even though the analysis was based on considerable experience and background information, it is essential that several important operating characteristics of the selected alternative systems be evaluated under field conditions prior to implementation consideration. An experiment incorporating the most promising alternative(s) is necessary to substantiate the effectiveness of the reduced staffing levels under actual field feeding conditions; the capability of the food delivery system to deliver hot food to the troops; and the effectiveness of disposables, if such an option is chosen.

Recommendations - As a result of the analysis performed herein, the following recommendations are made:

1. The plan for consolidation be further evaluated to determine its ability to adapt to different scenarios (i.e., adverse climatic conditions, unique theaters of operations, etc.).
2. The preferred alternative selected by the Army be subjected to validation and verification of performance and manpower savings by means of a field feeding experiment. This experiment should be jointly designed and conducted by TRADOC, FORSCOM and NIABS.
3. A final decision on consolidation be deferred until the results of the experiment are available.

APPENDIX A

PLAN FOR CONSOLIDATION

This appendix presents a summary of the type, number, and the distribution of the proposed kitchens under the plan for consolidation for the Armor, Infantry (Mechanized), and Infantry Divisions. Each divisional unit's mission, relationship to other divisional units, and relative location within the divisional area was considered in determining the capability to provide hot prepared food to the unit from some higher level consolidated kitchen. Table A-1 presents the detailed plan of consolidation for an Armor Division; i.e., the assignment of all divisional units to kitchens. Table A-2 presents the same type of information for an Infantry Division (Mechanized), while Table A-3 presents the same information for the Infantry Division. These three tables along with the tables for proposed staffing for various types of kitchens at the different levels of feeding form the basis for this entire report.

EXPLANATION OF SYMBOLS USED IN A-1, A-2 AND A-3

1. Type Kitchens

A	Area Kitchen
B	Battalion Kitchen
C	Company Kitchen
D	Consolidated Kitchen, other than battalion level
H	Headquarters Kitchen, formed by augmenting appropriate HHC company

(1C) Organic HHC company level kitchen, staffed at the appropriate level to feed the HHC companies TOE strength. The food service staffing will then be augmented by food service personnel from the Food Service Company to form the Headquarters mess team that also feeds all attachments to the HHC.

2. Bracket () Indicates these divisional units are consolidated for feeding purposes. If only one figure for strength is given after the bracket, this figure is a combined strength for the bracketed units.

3. Strength The strength figures are approximate and slight variations may exist because of changing TOE strengths. The strengths of attached units are estimates and may vary slightly.

4. S-T BN (-) The dash in parenthesis after a unit indicates that the entire unit is not being considered here but rather portions of the unit have been assigned elsewhere for feeding purposes.

Table A-4 presents a summary of Tables A-1, A-2, and A-3 in terms of the kitchen requirements by size. For example, all the kitchens for the three divisions in the row, KITCHEN CAPACITY - 100 TROOPS, will be staffed at the 100 man kitchen level when determining the manpower requirements for the consolidated systems. Staffing requirements per kitchen are solely a function of kitchen capacity and is not effected by the type of kitchen; that is, A,B,C,D, or H.

TABLE A-1
ARMOR DIVISION
**TROOP ASSIGNMENTS FOR CONSOLIDATED
FIELD FOOD SERVICE SYSTEMS**

TITLE	TOE	STRENGTH	NO./DIV	TOTAL DIV. STRENGTH	NO. & TYPE KITCHEN
DIV HQ					
HHC	17-4 H	464	1	464	1 H
MP (ATT)		189	1	189	(1 C)
Signal (ATT)		59	1	59	
BRIGADE HQ		216	1	216	
HHC	17-42 H	226	3	678	3 H
MP (ATT)		111	3	333	(3 C)
Signal (ATT)		31	3	93	
Rifle Platoon		48	3	144	
Tank Bn	17-35 H	36	3	108	
Inf Bn (M)	7-45 H	568	6	3408	6 B
Inf Bn (M)	7-45 H	871	5	4355	5 B
DIV ARTY					
HHB	6-302 H	231	1	231	1 C
FA Bn (155 mm Sp)	6-365 H	555	3	1665	
HHB	6-366 H	213	3	639	3 D
Service Battery	6-369 H				
155 Battery	6-367 H	114	9	1026	9 C
FA Bn (8" SP)	6-395 H	511	1	511	
HHB	6-396 H	163	1	163	1 D
Service Battery	6-399 H				
8" Battery	6-397 H	116	3	348	3 C
CAV SQUADRON	17-105 H	854	1	854	
HHT	17-106 H	190	1	190	1 D
Arm'd Cav Troop	17-107 H	166	3		
Air Cav Troop	17-108 H	166	1	166	1 C
SUPPORT COMMAND		340	1	340	1 H
HHC	29-2 H	122	1	122	(1 C)
S & T Bn Hq (ATT)	29-6 H	83	1	83	
Hq & Lt. Mnt. Co (ATT)	29-36 H	135	1	135	
Trans Acft (Mnt Bn)	55-424 H	111	1	211	1 D
Div Avn Co	17-87 H	100	1		
Med Bn	8-35 H	392	1	392	
Hq & S. Co	8-36 H	146	1	146	1 C
Med. Co.	8-37 H	82	3	246	3 C
SUBTOTAL				13,109	
AREA FEEDING					
S-T Bn (-)	29-115 H			385	
Mnt Bn (-)	29-35 H			780	
Fin Co	14-7 H			120	
AG Co	12-7 H			304	

TABLE A-1 (CON'T)

TITLE	TOE	STRENGTH	NO./DIV	TOTAL DIV. NO. & TYPE	
				STRENGTH	KITCHEN
ADA Bn	44-325 H			594	
Eng Bn	5-145 H			1012	
Signz? Bn (-)	11-35 H			311	
M Co (-)	19-27 H			38	
Non-Divisional Elements				400	
SUBTOTAL				3944	
DIVISION TOTAL				17053	

TABLE A-2
INFANTRY DIVISION (MECH)

TROOP ASSIGNMENTS FOR CONSOLIDATED
FIELD FOOD SERVICE SYSTEMS

TITLE	TOE	STRENGTH	NO./DIV	TOTAL DIV. STRENGTH	NO. & TYPE KITCHEN
DIV HQ		466	1	466	1 H
HHC	37-4 H	191	1	191	(1 C)
MP		59	1	59	
Signal (ATT)		216	1	216	
BRIGADE HQ		236	3	708	3 H
HHC	37-42 H	121	3	363	(3 C)
MP (ATT)		31	3	93	
Signal (ATT)		48	3	144	
Rifle Platoon		36	3	108	
Tank Bn	17-35 H	555	4	2220	4 B
Inf Bn (M)	7-45 H	877	5	4385	5 B
DIV ARTY					
HHB	6-302 H	240	1	240	1 C
FA Bn (155 MM Sp)	6-365 H	540	3	1620	
HHB	6-366 H	198	3	594	3 D
Service Battery	6-369 H				
155 Battery	6-367 H	114	9	1026	9 C
FA Bn (8" SP)	6-395 H	511		511	
HHB	6-396 H	163	1	163	1 D
Service Battery	6-399 H				
8" Battery	6-397 H	116	3	348	3 C
CAV SQUADRON	17-105 H	856	1	856	
HHT	17-106 H	190	1	689	1 D
Armd Cav Troop	17-107 H	166	3		
Air Cav Troop	17-108 H	167	1	167	1 C
SUPPORT COMMAND		347	1	347	1 H
HHC	29-2 H	129	1	129	(1 C)
S & T Bn Hq (ATT)	29-6 H	83	1	83	
Hq & Lt Mnt Co (ATT)	29-26 H	135	1	135	
Trans Acft (Mnt Bn)	55-424 H	111	1	211	1 D
Div Avn Co	37-87 H	100	1		
Med Bn	8-35 H	392	1	392	
Hq & S. Co	8-36 H	146	1	146	1 C
Med. Co	8-37 H	82	3	246	3 C
SUBTOTAL				11,956	
AREA FEEDING					
S & T Bn (-)	29-65 H			350	
Mnt Bn (-)	29-25 H			719	
Fin Co	14-7 H			110	
AG Co	12-7 H			313	
ADA Bn	44-325 H			581	
Eng Bn	5-145 H			994	

TABLE A-2 (CON'T)

TITLE	TOE	STRENGTH	NO./DIV	TOTAL DIV. NO. & TYPE	
				STRENGTH	KITCHEN
Signal Bn (-)	11-305 H			297	
MP Co (-)	19-274 H			27	
Non-Divisional Elements				400	
SUBTOTAL				3791	
DIVISION TOTAL				15747	

TABLE A-3

INFANTRY DIVISIONTROOP ASSIGNMENTS FOR CONSOLIDATED
FIELD FOOD SERVICE SYSTEMS

TITLE	TOE	STRENGTH	NO./DIV	TOTAL DIV. STRENGTH	NO. & TYPE KITCHEN
DIV HQ		460	1	460	1 H
HHC	7-4 H	184	1	184	(1 C)
MP (ATT)		59	1	59	
Signal (ATT)		216	1	216	
BRIGADE HQ		233	3	699	3 H
HHC	7-42 H	118	3	354	(3 C)
MP (ATT)		31	3	93	
Signal (ATT)		48	3	144	
Rifle Platoon		36	3	108	
Tank Bn	17-35 H	554	1	554	1 B
Inf Bn	7-15 H	799	7	5593	7 B
Inf Bn (M)	7-45 H	878	1	878	1 B
DIV ARTY					
HHB	6-301 H	239	1	239	1 C
FA Bn (105 T)	6-155 H	491	3	1473	
HHB	6-156 H	197	3	591	3 D
Service Battery	6-159 H				
105 T Battery	6-157 H	98	9	882	9 C
FA Bn (155/8" SP)	6-165 H	614	1	614	
HHB	6-166 H	193	1	193	1 D
Service Battery	6-169 H				
8" SP Battery	6-358 H	106	1	106	1 C
155 SP Battery	6-167 H	105	3	315	3 C
CAV SQUADRON	17-205 H	988	1	988	
HHT	17-206 H	272	1		
Air Cav Troop	17-208 H	184	3	988	1 B
Armd Cav Troop	17-207 H	164	1		
SUPPORT COMMAND		347	1	347	1 H
HHC	29-2 H	129	1	129	(1 C)
S & T Bn Hq (ATT)	29-6 H	83	1	83	
Hq & Lt Mnt Co (ATT)	29-16 H	135	1	135	
Avn Bn	7-75 H	341	1	341	
HHC	7-76 H	92	1	91	1 D
Avn GS Co	7-78 H	99	1		
Assault Hel Co.	7-77 H	150	1	261	1 D
Trans. Acft (Mnt Bn)	55-89 H	111	1		
Med Bn	8-35 H	376	1	376	
Hq. & S. Co	8-36 H	130	1	130	1 C
Med Co	8-37 H	82	3	246	3 C
SUBTOTAL				12673	

TABLE A-3 (CON'T)

TITLE	TOE	STRENGTH	NO./DIV	TOTAL DIV. STRENGTH	NO. & TYPE KITCHEN
AREA FEEDING					
S & T Bn (-)	29-5 H			327	
Mnt Bn (-)	29-15 H			574	
Fin Co	14-7 H			110	
AG Co	12-7 H			279	
ADA Bn	44-326 H			581	
Eng. Bn	5-155 H			791	
Signal Bn (-)	11-35 H			288	
MP Co (-)	19-27 H			37	
Non-Divisional Elements				400	
SUBTOTAL				3387	
DIVISION TOTAL				16060	

TABLE A-4
SUMMARY
KITCHEN REQUIREMENTS BY TYPE DIVISION

KITCHEN CAPACITY (TROOPS)	ARMORED No./Type KITCHEN	DIV Assigned Troop Strength	INFANTRY No./Type KITCHEN	DIV (MECH) Assigned Troop Strength	INFANTRY No./Type KITCHEN	DIV Assigned Troop Strength
100	3C	82	3C	82	3C	82
	3C-H	111 (226)	9C	114	9C	98
	9C	114	3C	116	3C	105
	3C	116	3C-H	121 (236)	1C	106
	1C-H	122 (340)	1C-H	129 (347)	3C-H	118 (223)
					1C-H	129 (347)
					1C	130
200	1C	146	1C	146	1C-H	184 (460)
	1D	163	1D	163	1D	191
	1C	166	1C	167	1D	193
	1C-H	189 (464)	1C-H	191 (466)	3D	197
	1D	211	3D	198		
	3D	213	1D	211		
	1C	231				
300			1C	240	1C	239
					1D	261
400	10A	400	10A	400	10A	400
600	6B	568	4B	555	1B	554
700	1B	688	1B	689		
800					7B	799
900	5B	871	5B	877	1B	878
1000					1B	988

APPENDIX B

EQUIPMENT ISSUE FACTORS

The amount and type of kitchen equipment presently utilized by the 4 Divisions; the Armor Division, 2 Infantry Divisions (Mech), and the Infantry Division was determined by performing a detailed analysis of the T.O.E.'s of those units comprising these divisions. To determine the amount and type of kitchen equipment required by the 4 divisions under the plan for consolidation (detailed in Appendix A), it was necessary to determine the resulting kitchen sizes and the issue factors for the various types of kitchen equipment as a function of kitchen size.

Table B-1 presents a detailed listing of the assigned kitchen strengths under the plan of consolidation for the 4 Divisions considered. This table is based on the information detailed in Table A-4. The second Infantry Division (Mechanized) is identical to the one detailed in Table A-2 with the addition of 1 Tank Bn (Strength 555) and 1 Infantry Bn (M) (Strength 877). All HHC company level messes that have been augmented to form headquarters messes (H) have been included in Table B-1 at their augmented strength.

Beginning with Table B-2 are the issue factors used for the various types of equipment to determine the kitchen equipment requirements for the 4 Divisions under the plan for consolidation. Table B-2 lists the issue factors used for Range Outfits/M-2 burners for kitchens of various strength and is based on AR 310-34. Table B-3 presents the issue factors for immersion heaters. The issue factors used for option A, is based on MIL-HDBK-740 which specifies one wash line (4 immersion heaters) is "capable of washing the mess kits of approximately 80 persons". Therefore, the assigned strength to each kitchen was rounded up or down to the nearest multiple of 80 to determine the number of wash lines the kitchen would be authorized. At the present time, the kitchen is not authorized any additional immersion heaters for the sanitation of pots, pans, and utensils. The issue factors for the number of Immersion heaters required under options B and C have been estimated and have been included in Table B-3. The issue factors for options B and C could probably be reduced further.

Table B-4 lists the issue factors for insulated food containers. All companies maintaining their own company level organic mess will maintain their current T.O.E. authorization of Insulated food containers, determined through an analysis of their T.O.E.'s. The issue factor for all consolidated and area kitchens was set at 1 insulated food container per 10 people subsisting. This issue factor, approximately double, (AR 310-34 states 1 container is capable of providing 1 hot meal for 25 individuals) was used because of the possible difficulty in getting the insulated food containers back to the consolidated kitchen facility in time for proper sanitation so that a second hot meal could be sent out to the troops the same day.

Table B-5 lists the issue factors for the 2-1/2 ton trucks, MKT's, kitchen tents, and water trailers, as a function of kitchen size. For the purpose of this analysis kitchen strengths were rounded up or down to the nearest multiple of 100 to determine how many units of each item the kitchen would be authorized.

Accessory packs were issued on the basis of 1 per 3 field ranges authorized.

The summary of the amount of kitchen equipment authorized/required according to the above issue factors is summarized in Table B-6 for alternatives 1, 2, and 3, each with options A, B, and C.

TABLE B-1
ASSIGNED KITCHEN STRENGTHS

No. Kitchens	Strength
12	82
9	98
3	105
1	106
27	114
9	116
1	130
3	146
3	163
1	166
2	167
1	191
1	193
3	197
6	198
3	211
3	213
3	223
3	226
1	231
6	236
1	239
2	240
1	261
1	340
3	347
40	400
1	460
1	464
2	466
1	554
9	555
6	568
1	688
2	689
7	799
5	871
11	877
1	878
1	988

TABLE B-2
RANGE/M-2 BURNER ISSUE FACTORS

Assigned Strength	Number Messes	Issue Factors
1 - 50	0	1
51 - 100	21	2
101 - 225	83	3
226 - 325	1	4
326 - 425	44	5
426 - 525	4	6
526 - 625	16	7
626 - 725	3	8
726 - 825	7	9
826 - 925	17	10
926 - 1025	1	11

TABLE B-3
IMMERSION HEATER ISSUE FACTORS

OPTION A

<u>Assigned Strength</u>	<u>Number Messes</u>	<u>Laundry Lines/Mess</u>
0 - 119	61	1
120 - 199	21	2
200 - 279	23	3
280 - 359	4	4
360 - 439	40	5
440 - 519	4	6
520 - 599	16	7
600 - 679	0	8
680 - 759	3	9
760 - 839	7	10
840 - 919	17	11
920 - 999	1	12

OPTION B AND OPTION C

<u>Assigned Strength</u>	<u>Number Messes</u>	<u>IMMERSION HEATERS/MESS</u>	
		<u>Option B</u>	<u>Option C</u>
0 - 349	109	4	3
350 - 649	60	8	6
650 - 999	28	12	9

SUMMARY

IMMERSION HEATER UNITS REQUIRED

Option A	3280
Option B	1252
Option C	939

TABLE B-4
INSULATED FOOD CONTAINERS - ISSUE FACTORS

Company Kitchens - will maintain current issue factor
 Area Kitchens - 40 containers per kitchen
 Consolidated Kitchens (any level) - 1 container per 10 subsisting

TABLE B-5
**2-1/2 TON TRUCKS, WATER TRAILERS, CARGO TRAILERS, KITCHEN TENTS,
MFKT'S ISSUE FACTOR**

With MFKT's	With Kitchen Tents ¹
Assigned Strength 100 - 300	100 - 300
1 2-1/2 Ton Truck with MFKT	1 2-1/2 Ton Truck - Cargo Trailer
1 2-1/2 Ton Truck - Water Trailer ²	1 2-1/2 Ton Truck - Water Trailer ²
Assigned Strength 400 - 600	400 - 600
2 2-1/2 Ton Truck with MFKT	1 2-1/2 Ton Truck w/Cargo Trailer
1 2-1/2 Ton Truck with Water Trailer	1 2-1/2 Ton Truck w/Water Trailer
Assigned Strength 700 - 1000	700 - 1000
3 2-1/2 Ton Truck with MFKT	1 2-1/2 Ton Truck w/Cargo Trailer
2 2-1/2 Ton Truck with Water Traiier	2 2-1/2 Tcn Truck w/Water Trailler

¹For kitchens operating out of tents, 1 M-48 kitchen tent will be authorized for kitchens feeding up to 549 individuals while 1 M-75 tent will be authorized for kitchens feeding 550 or more individuals.

²This truck is not issued to organic company level messes, in the 4 Divisions there are 72 such messes. This water trailer is pulled by the companies supply truck. All other company level units will also be issued a water trailer (that will be pulled by the units supply truck) that will provide water for drinking, personal hygiene, and the set-up of any mess kit wash lines required away from the kitchen site.

TABLE B-6
EQUIPMENT REQUIREMENTS

ITEM	PRESENT SYSTEM	Alternative		
		1	2	3
M-48 Kitchen Tent	461	153	40	0
M-75 Kitchen Tent	---	44	44	0
MFKT	---	0	109	313
Ranges/M-2 Burners ¹	1277	932	604	0
Accessory Packs ¹	451	311	202	0
2-1/2 Ton Trucks	441	350	350	466
Water Trailer	457	594	594	594
Cargo Trailers	441	197	88	0
Insulated Food Container				
Option A	2421	5679	5679	5679
Option B	----	5679	5679	5679
Option C	----	0	0	0
Immersion Heaters				
Option A	4136	3280	3280	3280
Option B	----	1252	1252	1252
Option C	----	939	939	939

¹ Does not include any that came as part of the MFKT

APPENDIX C
PROPOSED KITCHEN STAFFINGS AND PERSONNEL
REQUIREMENTS FOR PRESENT & ALTERNATIVE SYSTEMS

The total number of food service personnel by MOS and grade authorized for the 4 divisions was determined by performing a detailed analysis of the TOE's for those units comprising the 4 divisions. This information is summarized in Table C-1.

To determine the number of food service personnel required under the plan for consolidation (detailed in Appendix A) it was first necessary to determine the staffing requirements for various types of kitchens (i.e., M-1959/M-1975 or MFKT) when operating at various capacities. Table C-2 lists the staffing requirements for the M-1959 kitchen at various feeding levels, Table C-3 the staffing requirements for the M-1975 kitchen at various feeding levels, and Table C-4 the staffing requirement for the MFKT at various levels. Based on these staffing requirements, and the kitchen sizes resulting from consolidation (detailed in Table A-4), the manpower requirements by MOS and grade, for the present system and for Alternatives 1, 2, and 3, each with Options A, B, C is summarized in Tables C-5 and C-6.

TABLE C-1
FOOD SERVICE PERSONNEL REQUIREMENTS
FOR THE PRESENT SYSTEM

		DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4	TOTAL
Number of Kitchens		115	105	106	115	441
<u>MOS</u>	<u>GRADE</u>					
94B40	E-7	114	104	114	105	437
94B40	E-6	1	1	1	1	4
94B20	E-6	110	100	110	101	421
94B20	E-5	216	202	219	201	838
94B20	E-4	160	148	163	155	626
94250	E-8	1	1	1	1	4
94250	E-7	1	1	1	1	4
941A	W-3	5	5	5	5	20
4130	O-3	1	1	1	1	4
4130	O-2	1	1	1	1	4
SUBTOTALS		610	564	616	572	2362
Kitchen Attendants E-2		<u>446</u>	<u>410</u>	<u>452</u>	<u>417</u>	<u>1725</u>
TOTALS		1056	974	1068	989	4087

TABLE C-2
M-1959 KITCHEN STAFFING

Number Troops Assigned		100	200	300	400	500
Job Title	Grade					
Mess Steward	E7	1	1	1	1	1
First Cook	E6	1	1	1	2	2
Cook	E5	1	2	2	2	2
Cook	E4	1	1	2	2	2
Apprentice Cook	E3	—	—	—	—	2
TOTAL FOOD SERVICE PERSONNEL		4	6	7	8	9
 Attendants Required						
Option A		3	4	5	6	7
Option B		2	3	4	4	5
Option C		2	3	4	4	5

TABLE C-3
M-1975 KITCHEN STAFFING

Number Troops Assigned		600	700	800	900	1000
Job Title	Grade					
Mess Steward	E7	1	1	1	1	1
First Cook	E6	2	2	2	2	3
Cook	E5	2	2	2	2	2
Cook	E4	2	2	2	3	3
Apprentice Cook	E3	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>
TOTAL FOOD SERVICE PERSONNEL		9	10	10	11	12
Attendants Required						
Option A		9	10	11	13	14
Option B		6	6	7	8	9
Option C		5	5	6	7	8

TABLE C-4
MFKT STAFFING

Equipment Authorized		1 MFKT			2 MFKT's			3 MFKT's			
Number of Troops Assigned		100	200	300	400	500	600	700	800	900	1000
Title	Grade										
Mess Steward	E7	1	1	1	1	1	1	1	1	1	1
First Cook	E6	1	1	1	2	2	2	3	3	3	3
Cook	E5	1	1	2	2	2	2	2	2	2	2
Cook	E4	1	1	1	2	2	2	3	3	3	3
Apprentice Cook	E3	—	—	—	2	2	2	2	3	3	3
TOTAL FOOD SERVICE PERSONNEL		4	5	6	9	9	9	11	12	12	12

Attendants Required

Option A	3	4	5	6	7	9	10	11	13	14
Option B	2	3	4	4	5	6	6	7	8	9
Option C	2	3	4	4	5	5	5	6	7	8

TABLE C-5
FOOD SERVICE STAFFING REQUIREMENTS FOR PRESENT AND
ALTERNATIVE CONSOLIDATED SYSTEMS BY MOS

MOS	TITLE	PRESENT	ALTERNATIVE		
			1	2	3
	Div F.S. Ofcr	0	4	4	4
4130	Subsistence Ofcr	8	8	8	8
941A0	F.S. Tech.	20	20	20	20
94250	F.S. Supervisor	8	8	8	8
94B40	Mess Steward	441	197	197	197
94B20	Cook	1885	1128	1093	1167
	MISC ¹	—	76	76	76
TOTAL		2362	1441	1406	1480
Attendants	Option A	1725	1104	1104	1104
	Option B	--	733	733	733
	Option C	--	689	689	689

¹Personnel from the Food Service Company with other than a food service MOS.

TABLE C-6
 FOOD SERVICE STAFFING REQUIREMENTS FOR PRESENT AND ALTERNATIVE
 CONSOLIDATED SYSTEMS BY GRADE

GRADE	PRESENT	Alternative		
		1	2	3
04	0	4	4	4
03	4	8	8	8
02	4	16	16	16
W03	20	20	20	20
E8	4	8	8	8
E7	441	209	209	209
E6	425	294	294	325
E5	838	320	289	293
E4	626	371	367	365
E3	---	191	191	232
TOTAL	2362	1441	1406	1480
Attendants				
Option A	1725	1104	1104	1104
Attendants				
Option B	----	733	733	733
Attendants				
Option C	----	689	689	689

APPENDIX D

DERIVATION OF UNIFORM ANNUAL LABOR COSTS

Enlisted Food Service Workers:

Salary & Benefits:

These costs are incurred annually and vary for each pay grade. Effective October 1, 1974 the composite rates for the following grades are:

E-3	-	\$7,072	E-6	-	\$11,303
E-4	-	8,042	E-7	-	13,330
E-5	-	9,584	E-8	-	15,666

Support Costs:

This factor is also incurred annually but remains constant for the different pay grades. The total Army wide variable support cost is \$2945 per military man-year.¹

Training Costs:

Training costs are incurred only once for each phase of training and, therefore, have to be adjusted to a uniform annual cost. As stated in Chapter VI, the discount rate is 10%. For the enlisted food service personnel the analysis is modeled on two grades, E-4 (to represent E-3, E-4, E-5) and E-7 (to represent E-6, E-7, E-8).

For the E-4 model the following assumptions are made:

1. 66% that enlist leave after 4 years (per TSA, Ft. Lee, VA).
2. Of the 34% that remain 60% stay for a career, i.e., 20 years (per TSA, Ft. Lee, VA).
3. Those who remain for more than four but do not stay for a career average 12 years of service.
4. Actual training costs incurred are the weighted variable costs for MOS Training,² which are:

BCT & AIT -- \$2278 94B40 -- \$5003

5. An E-4 has served an average of 3 years.

¹"Summary Cost Data Book for Army Managers," Directorate of Cost Analysis, Office, Comptroller of the Army, Washington, D.C., July, 1974.

²"Military Occupational Specialty Training Cost Handbook," Volume I, Enlisted MOS'S, Directorate of Cost Analysis, Office, Comptroller of the Army, Washington, D.C., July, 1974.

The uniform annual training costs for an E-4 are then expressed by the following equation:

$$\begin{aligned}\text{Training Costs (E-4)} &= .66 (2278) (\text{crf}^* - 10\% - 4 \text{ years}) \\ &\quad + .34 (.60) (2278) (\text{crf}^* - 10\% - 20 \text{ years}) \\ &\quad + .34 (.40) (2278) (\text{crf} - 10\% - 12 \text{ years}) \\ &= 452 + 52 + 43 = \$547\end{aligned}$$

For an E-7, the following assumptions are made:

1. 80% stay for a career (20 years)
2. The 20% that don't remain for a career average 12 years of service
3. Training for 94B40 occurs in the fifth year

The uniform annual training costs for an E-7 are then given by the following equation:

$$\begin{aligned}\text{Training Costs (E-7)} &= .80 (2278) (\text{crf} - 10\% - 20 \text{ years}) \\ &\quad + .80 (5003) (\text{crf} - 10\% - 20 \text{ years}) (\text{pwf}^{**} - 10\% - 5 \text{ years}) \\ &\quad + .20 (2278) (\text{crf} - 10\% - 12 \text{ years}) \\ &\quad + .20 (5003) (\text{crf} - 10\% - 12 \text{ years}) (\text{pwf} - 10\% - 5 \text{ years}) \\ &= 204 + 292 + 64 + 91 = \$651\end{aligned}$$

Rotation Costs:

As in training costs, a 10% discount factor is used to obtain a uniform annual rotation cost. Duty assignments presently average 2 years duration. An assumption is that 90% of the assignments are within CONUS. The uniform annual rotation costs are then calculated as follows:

$$\begin{aligned}&= [.90 (\$651) + .10 (1286)] [\text{crf} - 2 \text{ years} - 10\%] \\ &= \$350.\end{aligned}$$

Initial Clothing & Accession Costs:

Actual initial clothing and accession costs are \$506. The formula used for a uniform annual cost is the same as for training costs. Thus:

$$\begin{aligned}&= .66 (506) (\text{capital recovery factor} - 4 \text{ years} - 10\%) + \\ &\quad .34 (.60) (506) (\text{crf} - 20 \text{ years} - 10\%) + \\ &\quad .34 (.40) (506) (\text{crf} - 12 \text{ years} - 10\%) \\ &= 100 + 12 + 10 = \$122\end{aligned}$$

* Capital recovery factor

** Present worth factor

Summary:

The total uniform annual costs for enlisted personnel incurred for each pay grade for cooks is summarized in the following table:

	<u>E-3</u>	<u>E-4</u>	<u>E-5</u>	<u>E-6</u>	<u>E-7</u>	<u>E-8</u>
Salary & Benefits	\$7,072	\$8,042	\$9,584	\$11,303	\$13,330	\$15,666
Support Costs	2,945	2,945	2,945	2,945	2,945	2,945
Training Costs	547	547	547	651	651	651
Rotation Costs	350	350	350	350	350	350
Initial Clothing & Accession Costs	<u>122</u>	<u>122</u>	<u>122</u>	<u>122</u>	<u>122</u>	<u>122</u>
Total Uniform Annual Cost	\$11,036	\$12,006	\$13,548	\$15,371	\$17,398	\$19,734

E-2 Kitchen Attendants

Salary & Benefits:

Salary and benefits for an E-2 (effective 1 October 1974) are \$6,092.

Support Costs:

Support costs are the same as for enlisted food service personnel, i.e., \$2945.

Training Costs:

For E-2 Kitchen Attendants the following assumptions are made:

1. 33% leave after one enlistment (4 years)
2. 33% stay for a career (20 years)
3. The remaining 33% average 12 years of service
4. BCT training costs are \$1739²

The uniform annual training costs for E-2's are given by the equation:

$$\begin{aligned} \text{Training Costs} = & (.33) (1739) (\text{crf} - 10\% - 4 \text{ years}) \\ & + (.33) (1739) (\text{crf} - 10\% - 20 \text{ years}) \\ & + (.33) (1739) (\text{crf} - 10\% - 12 \text{ years}) \end{aligned}$$

$$= 173 + 64 + 80 = \$317$$

Rotation Costs:

Rotation costs are assumed to be the same as for enlisted food service personnel, i.e., \$350.

Initial Clothing & Accession Costs:

Actual costs are the same as for enlisted food service personnel the formula for a uniform annual cost is:

$$\begin{aligned} &= .33 (506) (\text{crf } 10\% - 4 \text{ years}) + \\ &.33 (506) (\text{crf } - 10\% - 20 \text{ years}) + \\ &.33 (506) (\text{crf } - 10\% - 12 \text{ years}) + \end{aligned}$$

$$= 50 + 19 + 23 = \$92$$

Summary:

The total uniform annual cost for an E-2 kitchen attendant is:

Salaries & Benefits	\$6,092
Support Costs	2,945
Training Cost	317
Rotation Cost	350
Initial Clothing & Accession Cost	92
<hr/>	
Total Uniform Annual Costs	\$9,796

FOOD SERVICE OFFICERS:

Salary & Benefits

Effective October 1, 1974 the composite rates for the following grades are:

0-4	-	\$21,856
0-3	-	18,728
0-2	-	14,806
W-3	-	17,868

Support Costs:

Support Costs for officers are the same as for enlisted personnel, \$2945.

Training Costs:

Training costs for MOS 4130 are \$7230³. Assumptions here are:

1. Warrant Officers average 20 years of service
2. O-4's average 15 years of service
3. O-2's, O-3's average 10 years of service

Uniform annual training costs are then:

Warrant Officers

$$\begin{aligned} &= 7230 (\text{crf} - 10\% - 20 \text{ years}) \\ &= 7230 (.11194) = \$809 \end{aligned}$$

O-4's

$$\begin{aligned} &= 7230 (\text{crf} - 10\% - 15 \text{ years}) \\ &= 7230 (.12531) = \$906 \end{aligned}$$

O-2's, O-3's

$$\begin{aligned} &= 7230 (\text{crf} - 10\% - 10 \text{ years}) \\ &= 7230 (.15511) = \$1121 \end{aligned}$$

Rotation Costs:

Actual rotation costs for officers are \$2344 for intra-CONUS rotations and \$2902 a move between CONUS and overseas³. As with enlisted personnel it is assumed that 90% of the rotations occur intra-CONUS. Average tour of duty is assumed to be 3 years. The uniform annual rotation costs are then given by the following equation:

$$\begin{aligned} \text{Rotation Costs} &= (.90 (2344) + .10 (2902)) (\text{crf} - 10\% - 3 \text{ years}) \\ &= (2110 + 290) (.38329) = \$920 \end{aligned}$$

Initial Clothing & Accession Costs:

Actual cost is \$1122. Uniform annual initial clothing and accession costs are then given by:

Warrant Officers

$$\begin{aligned} &= 1122 (\text{crf} - 10\% - 20 \text{ years}) \\ &= 1122 (.11194) = \$126 \end{aligned}$$

O-4's

$$\begin{aligned} &= 1122 (\text{crf} - 10\% - 15 \text{ years}) \\ &= 1122 (.12531) = \$141 \end{aligned}$$

³"Military Occupational Specialty Training Cost Handbook," Volume II, Commissioned and Warrant Officers MOS'S, Directorate of Cost Analysis, Office, Comptroller of the Army, Washington, D.C., May, 1974.

0-2's, 0-3's

$$=1122 (\text{crf} - 10\% - 10 \text{ years}) \\ =1122 (.15511) = \$174$$

Summary:

The total Uniform Annual Costs for Food Service Officers are then:

	<u>0-4</u>	<u>0-3</u>	<u>0-2</u>	<u>W-3</u>
Salaries & Benefits	\$21,856	\$18,728	\$14,806	\$17,868
Support Costs	2,945	2,945	2,945	2,945
Training Costs	906	1,121	1,121	809
Rotation Costs	920	920	920	920
Initial Clothing & Accession Costs	<u>141</u>	<u>174</u>	<u>174</u>	<u>126</u>
Total Uniform Annual Costs	\$26,768	\$23,888	\$19,966	\$22,668

APPENDIX E
DETAILED COST DERIVATIONS
FOR PRESENT SYSTEMS

Food Costs:

Food costs are calculated on a total strength for the four divisions of 64,223 men and are based on the following combination of menus and costs.

Type of Menu	\$ Total	Cost per Ration	Weighted Costs
28 day Viet Nam ("A")	70.58	\$2.48	1.75
10 day Standard "B"	6.42	2.20	.14
Operational Rations	23.00	3.83	.88
TOTAL			\$2.77

These percentages take into account that 23% of all rations will be operational. In addition, during the initial month of the operation those meals not operational will be "A" and "B" rations. Food costs are averages over the entire menu cycles and are based 1 December, 1974 food costs.

Total Annual food cost is then:

$$\begin{aligned} & \$2.77 \times 365 \text{ days/year} \times 64,223 \\ & = \$64,932,664 \end{aligned}$$

Since the menus and price of "A", "B", and operational rations remain the same for all alternatives this cost will be constant throughout.

Labor Costs:

The total uniform annual cost for labor is shown in Table E-1.

From this table it is seen that the total officers' costs represent only 1.1% of the total labor costs, while kitchen attendants constitute 32.1% of these costs.

TABLE E-1
TOTAL UNIFORM ANNUAL LABOR COSTS
PRESENT SYSTEM

GRADE	COST BY GRADE	NUMBER OF PERSONNEL	TOTAL ANNUAL COST	% TOTAL
<u>FOOD SERVICE PERSONNEL:</u>				
O-3	\$23,888	4	\$95,552	0.2
O-2	19,966	4	79,864	0.2
W-3	22,668	20	453,360	0.9
E-8	19,734	4	78,936	0.2
E-7	17,398	441	7,672,518	15.1
E-6	15,371	425	6,532,675	12.9
E-5	13,548	838	11,353,224	22.4
E-4	12,006	626	7,515,756	14.8
<u>KITCHEN ATTENDANTS:</u>				
E-2	9,796	1725	<u>16,898,100</u>	<u>33.3</u>
		SYSTEM TOTAL COST	\$50,679,985	100.0

TABLE E-2

**UNIFORM ANNUAL COST
FOR EQUIPMENT FOR
THE PRESENT SYSTEM**

(A) Unit Cost	(B) Total Number Required	(C) Total Cost (A & B)	(D) Economic Life	Uniform Annual Cost (C ÷ D);
Accessory Outfit	\$83	451	\$37,433	12
Insulated Food Container	61	2421	147,681	12
Immersion Heater	80	4136	330,880	12
Field Range	671	1277	856,867	12
M-48 Tent	482	461	222,202	4
Water Trailer	1,920	457	877,440	6
Cargo Trailer	1,049	441	462,609	6
2 1/2 Ton Truck	9,380	441	4,136,580	6
Refrigeration Equipment*	—	—	—	159,472
				TOTAL SYSTEM EQUIPMENT COST \$1,242,199

* See detailed analysis.

Equipment Costs:

Annual refrigeration equipment costs are calculated as follows.

REFRIGERATION EQUIPMENT PER DIVISION

	<u>Quantity</u>	<u>Unit Cost</u>	<u>Total Cost</u>	<u>Economic Life</u>	<u>Annual Cost</u>
400 cu ft. Reefers	2	8,230	16,460	12	1,372
Refrig Units Mech Type	8	1,701	13,608	12	1,134
Semi Trailer - Refrig	19	7,986	151,734	12	12,644
Truck Tractors	10	14,831	148,310	6	<u>24,718</u>
				TOTAL	\$39,868

$$39,868 \times 4 \text{ divisions} = \$159,472$$

Given the assumption stated previously, that the age of the equipment presently being used is homogeneous, the uniform annual cost of replacement equipment is calculated in Table E-2.

Fuel Costs:

Fuel costs are calculated on an average kitchen size of 146 men (64,223 total strength divided 441 kitchens) and consist of the following components. The .77 factor accounts for no fuel requirements for operational rations.

gallons per
kitchen per day

Messkit-Sanitation:

$$2 \text{ Immersion Heater Lines} \times 4 \text{ burners per line} \times 12 \text{ hours per burner} \times .428 \text{ gallons per hour} = 41.088$$

Cooking:

$$3 \text{ M-2 burners} \times 12 \text{ hours per day} \times 0.5 \text{ gallons per hour} = 18.000$$

Pot and Utensil Sanitation:

$$2 \text{ immersion Heaters} \times 12 \text{ hours per day} \times .428 \text{ gallons per hour} = 10.272$$

Refrigeration:

$$\text{Consumption is 288 gallons per day/division} \\ 288 \times 4 \text{ divisions} \div 44 \text{ kitchens} \quad \underline{2.612}$$

$$\text{TOTAL} \quad 71.972$$

Adjustment for operational rations $71.972 \times .77^* = 55.418$ gallons/kitchen/day
Total Annual fuel cost for Corps=
 55.418 gallons/kitchen/day $\times 441$ kitchens
 $\times 365$ days/year $\times \$.4372/\text{gallon} = \$3,899,981$

Water Costs:

Water costs are calculated on an average kitchen size of 146 men, and are comprised of the following elements:

	gallons/kitchen per day
<u>Drinking & Personal Hygiene:</u>	
146×3 gallons/day	438
<u>Messkit-Sanitation:</u>	
2 lines $\times 80$ gallon/line/day $\times 3$ meals/day =	480
<u>Cooking:</u>	
146 men $\times .46$ gallons/man/day =	67
<u>Pots & Utensils Sanitation:</u>	
2 Immersion heaters 2×75 gallons/meal $\times 3$ meals/day =	<u>450</u>
	1435

Water cost is \$.005 per gallon based on labor costs of water supply units.

Annual water costs are then:

$$1435 \times 441 \text{ kitchens} \times 365 \text{ days/year} \times .005 = \$1,154,924$$

Transportation Costs:

Transportation costs for food are .367 per ration from the United States to the brigade trains which are assumed to be 75 miles from the rear depot. This weighted cost factor reflects the assumed proportions of "A", "B", and operational rations stated previously. Total annual cost to transport food is then:

$$\begin{aligned}.367 \times 365 \text{ days} \times 64,223 \text{ men} = \\ = \$8,602,992\end{aligned}$$

*Percentage of hot meals consumed which require disposable trays. Remaining meals are individual operational rations.

APPENDIX F

DETAILED COST DERIVATIONS FOR ALTERNATIVE SYSTEMS

Labor Costs:

Detailed labor costs are presented in Table F-1 based on manpower requirements, and uniform annual labor costs are derived in Appendix D.

Equipment Costs:

Equipment is analyzed in two categories, - that equipment which presently is being used in the present system and that which is new. Within each category the analysis is done in two parts, - those pieces of equipment which change with alternatives and those which change with options. It is assumed that equipment that is presently being used is homogeneous in age as stated previously. New equipment will be discounted with a capital recovery factor at 10% rate per AR 35-13.

Present Equipment Annual Costs:

Alternatives

<u>Options</u>	<u>1</u>	<u>2</u>	<u>3</u>
A	\$1,054,000	\$1,003,000	\$1,129,000
B	1,040,000	989,000	1,115,000
C	1,009,000	958,000	1,084,000

New Equipment (Using Capital Recovery Factors) Costs:

Alternative 1

	Unit Cost	Units Required	Total Cost	Economic Life	Uniform Annual Cost
M-75 Tent	\$2,000	44	\$88,000	4	\$26,458
MFKT	8,000	0	0	11*	0
				TOTAL	\$26,458

Alternative 2

	Unit Cost	Units Required	Total Cost	Economic Life	Uniform Annual Cost
M-75 Tent	\$2,000	44	\$88,000	4	\$26,458
MFKT	8,000	109	872,000	11*	127,957
				TOTAL	\$154,415

Alternative 3

	Unit Cost	Units Required	Total Cost	Economic Life	Uniform Annual Cost
M-75 Tent	\$2,000	0	0	4	0
MFKT	8,000	313	2,504,000	11*	\$367,437
				TOTAL	\$367,437

* Weighted life between equipment and trailer.

TABLE F-1
LABOR COSTS FOR
ALTERNATIVE SYSTEMS

FOOD SERVICE PERSONNEL:

GRADE	NUMBER OF PERSONS	ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3	
		TOTAL COST	NUMBER OF PERSONS	TOTAL COST	NUMBER OF PERSONS	TOTAL COST	
0-4	4	\$107,072	4	\$107,072	4	\$107,072	
0-3	8	191,104	8	191,104	8	191,104	
0-2	16	319,456	16	319,456	16	319,456	
W-3	20	453,360	20	453,360	20	453,360	
E-8	8	157,872	8	157,872	8	157,872	
E-7	209	5,636,182	209	5,636,182	209	5,636,182	
E-6	294	4,519,074	294	4,519,074	325	4,995,575	
E-5	320	4,335,360	289	3,915,372	293	3,969,564	
E-4	371	4,454,226	367	4,406,202	365	4,382,190	
E-3	191	2,107,876	191	2,107,876	232	2,560,352	
TOTAL	1441	\$20,281,582	1406	\$19,813,570	1480	\$20,772,727	

KITCHEN ATTENDANTS (E-2):

OPTION A	1104	\$10,814,784	1104	\$10,814,784	1104	\$10,814,784
OPTION B	733	7,180,468	733	7,180,468	733	7,180,468
OPTION C	689	6,749,444	689	6,749,444	689	6,749,444
TOTAL LABOR COSTS:						
OPTION A	2545	\$31,096,366	2510	\$30,628,354	2584	\$31,587,511
OPTION B	2174	27,462,050	2,39	26,994,038	2213	27,953,195
OPTION C	2130	27,031,026	2095	26,563,014	2169	27,522,171

Equipment Cost (Cont'd):

Total Equipment Annual Costs:

		<u>Alternatives</u>		
		<u>1</u>	<u>2</u>	<u>3</u>
<u>Options</u>	A	\$1,080,000	\$1,157,000	\$1,496,000
	B	1,066,000	1,143,000	1,482,000
	C	1,035,000	1,112,000	1,451,000

Fuel Costs:

Total Strength of the four divisions remains the same at 64,223 men. With 197 consolidated kitchens for each of the three alternatives the average kitchen size is 326 men. Based on this average, fuel costs are calculated as follows using the same criteria and rates as used in the present system. Fuel costs vary only for the options, not the alternatives.

<u>Options</u>										
Consumption Rate per unit per day		<u>A</u>	<u>B</u>	<u>C</u>	# Units	Gallons	# Units	Gallons	# Units	Gallons
Messkit Sanitation:										
Immersion Heater	20.544	4	82.176	0	0.000	0	0.000	0	0.000	
Cooking:										
M-2 Burners	6.00	5	30.000	5	30.000	5	30.000	5	30.000	
Pot & Utensil Sanitation:										
Immersion Heater	5.136	4	20.544	4	20.544	3	15.408			
Refrigeration:	5.224	1	5.224	1	5.224	1	5.224			
TOTALS			137.944		55.768		50.632			
Operational Ration Factor Adjusted Daily Food Cost/Kitchen			.77		.77		.77			
			<u>106.217</u>		<u>42.941</u>		<u>36.987</u>			
Multiply 197 kitchens, 365 days/year and \$.4372/ gal the Total Annual Fuel Costs are:			\$3,339,130		\$1,349,930		\$1,225,629			

Water Costs:

Water costs are based on an average kitchen size of 326 men and are based on the following elements. As with fuel, water consumption varies only among options not alternatives basic rates of consumption are the same as those used in Appendix E for the present system.

	Consumption Rate in gallons per unit/day	<u>Options</u>		<u>A</u>		<u>B</u>		<u>C</u>	
		# Units	Gallons	# Units	Gallons	# Units	Gallons	# Units	Gallons
Drinking & Personal Hygiene	3	326	978	326	978	326	978	326	978
Messkit Sanitation Lines	240	4	960	0	0	0	0	0	0
Cooking	.46	326	150	326	150	326	150	326	150
Pots & Utensil Sanitation	225	4	<u>900</u>	4	<u>900</u>	3	<u>675</u>		
TOTALS			2988		2028		1803		

Total Annual Water Costs are (\times 365 days \times 197 kitchens \times \$.005/gal): \$1,074,261 \$729,117 \$648,224

Disposable Costs:

Disposable costs are dependent only on the option adopted. None are used in Option A so these costs are zero. Option B costs consist of a tray, three utensils, and a sanitizing wipe per meal. Option C costs, in addition, include disposable food containers and serving utensils.

Option B

3 utensils - .034500
1 sanitizing wipe - .009625
1 tray - .030000
\$.074125/meal

$64,233 \text{ men} \times 3 \text{ meals} \times 365 \text{ days per year} \times .77^* = 54,149,622 \text{ hot meals}$
 $54,149,622 \times .074125 = \$4,013,831$

Option C

One disposable insulated food container kit for 20 persons costs \$8.00 (including trays, sanitizing wipes, eating and serving utensils, etc.)
 $64,223 \text{ men} \div 20 \text{ men/kit} \times 3 \text{ meal/day} \times 365 \text{ day/year} \times .77^* = 2,707,481 \text{ kits}$
 $2,707,481 \times \$8.00/\text{kit} = \$21,659,849$

* Percentage of hot meals consumed which required disposable trays. Remaining meals are individual operational rations.

Transportation Costs:

Yearly transportation costs from the United States to the brigade trains, which one assumed to be 75 miles from the rear depot are estimated below for Options B and C.

Option A

Food	\$8,602,992
TOTAL ANNUAL COST:	<u>\$8,602,992</u>

Option B

Food	\$8,602,992
Disposable trays and utensils (54,149,622 each)	
to rear depot	567,757
Disposable trays and utensils within theater	<u>27,232</u>
TOTAL ANNUAL COST:	\$9,197,981

Option C

Food	\$8,602,992
Disposable kits (2,707,481) to rear depot	6,181,179
Disposable kits within theater	296,478
TOTAL ANNUAL COST:	\$15,080,649